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The Purpose of The American Orthopaedic Association

Delivered Before the American Orthopaedic Association, Washington, May 4, 1925

BY EDWIN W. RYERSON, M.D., CHICAGO, ILL.

Members of the American Orthopaedic Association and Guests:

It is my pleasant duty to welcome you to the thirty-ninth annual meeting of this Association. The address of each President at the Annual Meeting marks for him, and for him alone, a momentous and soul-stirring occasion.

It represents the first, the last, and the only period in his career when he is permitted to read a paper which nobody else can discuss or criticize on the floor. It is, as the cartoonist would say, "a grand and glorious feeling."

It is now twenty-six years since I began the practice of medicine and surgery. For twenty years I have been a member of this Association, and I have been present at practically every meeting during these years.

Looking backward over this period, what things have we attempted and what have we accomplished? We come together each year to interchange our experiences and our opinions; to learn from many, to instruct a few.

No man has ever gone away from one of these gatherings without having received help in some of his problems, without having some of his uncertainties made more certain, without having a distinct impetus given to his interest in his daily work. The newer ideas are brought forth,

discussed, and criticized, sometimes discarded, sometimes supported and adopted. The chaff is separated from the wheat by the simple and effective method of threshing on the floor. Some of us get considerably battered in the process, but it is healthful and good for the soul. It is also beneficial to the future patients.

Our meetings should be the Clearing House of American orthopaedic surgery. We should come here prepared to defend our views if we feel certain that they are well-founded, or to abandon them if sufficient adverse evidence be adduced by other workers.

The reports of the Commissions on Scoliosis, Congenital Hip Dislocations, and Infantile Paralysis were of great value in settling some of the undetermined problems. It is to be hoped that other Commissions will be appointed to study some of our other problems. For example, there is a wide variance of opinion as to the best method of dealing with the "cold" abscesses encountered in tuberculous joint disease. Many of our members believe that such collections of almost inert waste-products should be opened and drained; others contend that they should be left absolutely to Nature; while still a third group supports the middle ground of aspiration, with or without the injection of chemicals.

A second problem is presented in the repair of fractures. Some surgeons believe that bony union is favored by holding the fragments in as perfect immobilization as is possible. Others think that a reasonable degree of motion between the fragments is advantageous. I do not know that any scientific study of this question has been reported.

Do we all agree as to the methods or the apparatus to be used in cases of hip-joint tuberculosis, or congenital club feet, or scoliosis? No, we do not: and yet there must be one form of treatment for a given disease or disability which is better than most or all of the other methods. In opposition to this principle it is not a cogent argument to say that each case is different from each other case in the same class, and that each case needs, therefore, a different form of treatment. There is, in reality, a basic similarity in all cases of a given kind, and there must be a fundamental similarity in the proper treatment.

Is there any way of harmonizing these widely divergent views of a hundred competent, earnest, truth-seeking orthopaedic surgeons?

It may be an idle Utopian dream, in consideration of our dark and bloody past, but I think we shall eventually come to a reasonable agreement about some of the well-recognized and carefully studied conditions.

There is much talk nowadays of the inadvisability of definite standardization of methods, of education, of ideals. Critics object to a pre-

arranged standard curriculum in the schools, the colleges, the medical departments. Each student, they say, must be allowed to choose his own field of endeavor, to follow his own fancies, to develop his own individuality. I do not believe that this is the wisest way to educate our young people. I do not believe that many students in our colleges and medical schools are capable of deciding intelligently what courses to take and what courses to omit. I believe that all medical schools should have definite and well-considered curricula which will impart exactly the same knowledge to all of the students through at least four years of training. At the end of this course they will be well prepared to decide whether they will become surgeons, or general practitioners, or specialists, and the people who employ them will know that certain definite facts and principles have been mastered. Too many young men are emerging from our schools as full-fledged specialists without having had the ambition or the opportunity to become familiar with general practice. In ancient days Cadmus planted the dragon's teeth, and fully matured and completely armed warriors sprang forthwith from the ground. This was a simple and excellent system, but the formula was lost some years ago. We now have to bring up our medical warriors by a different method, and we have departed, of late years, too far from safe and sane standardization.

Do I hear voices raised in protest? Yes, I do: but I do not have to pay any attention to them on this festal day.

The point I wish to make is that the American Orthopaedic Association has been harrowed by no fears of standardization. For many years we have been coming together each spring to interchange our ideas, and up to this present time we have not been able to agree as a unit upon one single proposition in the field of orthopaedic surgery. This is an example of perfect consistency. Each of us has designed a new and very much better hip splint, a different operation for bunions, and a superlative foot-plate for feet which usually would be better without any foot-plate at all.

None of us has discovered the cause of osteochondritis deformans juvenilis, nor whether bone-grafts live or die, nor why congenitally dislocated hips leave home.

What I hope may happen is that under our next President we may begin to standardize some of our ideas and methods so that we shall present in most details a solid and harmonious group of honest and able men who love orthopaedic surgery.

SKIN FLAP METHODS IN THE UPPER EXTREMITY

ARTHUR STEINDLER, M.D., F.A.C.S., IOWA CITY, IOWA

The great number and variety of congenital and acquired contractures and deformities of the upper extremity involving the skin offers a fertile field for the application of the various methods of skin plasties, the most suitable perhaps being those of the skin flap variety. In general, the technique of whole skin pedicled flap transposition, both local and remote, is a matter well established and universally recognized. In regard to details, however, especially as they concern the application of the method to the upper extremity, I think it well to mention a series of points, made by various observers and investigators upon anatomic as well as physiologic grounds, which are of considerable importance in the interest of operative results.

1. The Flap. Before selecting the site and position of the flap, its tension and circulatory condition must be considered. The natural lines of cleavage of the skin determine to a great extent the amount of retraction and shrinkage of the flap as it is raised from its bed. As much as feasible the long sides of it should be chosen parallel to the lines of tension, but as the diagram of cleavage line shows, this is not always practicable.

Of much greater importance for the outlining of the flap are its circulatory conditions. Pieri and Manchot have studied the skin circulation in the pertinent regions of the body and extremities with the object of determining the most suitable location of the flap from the viewpoint of its nutrition. The diagrams show that over the abdomen the free ends of the flap more or less converge toward the umbilicus, while in the upper extremity, in the upper arm and forearm, a more transverse position gives the best circulatory conditions. (Fig. 1.)

A broad pedicle is desirable in the interests of the vitality of the flap, and its length should not exceed two or three times the width. No more than one-fourth to one-third of the diameter need to be allowed for shrinkage in a medium sized flap, although in young, rapidly growing, and well nourished children the skin is under somewhat greater tension, and the flap will shrink more when severed from its surroundings.

Regarding the different types of pedunculated flaps, there were used the sliding flaps of the French method as well as the Indian method of pedunculated flaps with twisted pedicles, and the Tagliacotian or Italian

method of abdominal flaps, the latter being used frequently, the former methods only occasionally.

2. The Bed. A thorough resection of all scar tissue is necessary before the bed is prepared to receive the transplanted flap. If transplantation is made upon a fresh wound (and this was the case in the large majority), the most painstaking hemostasis is essential so as to avoid the accumulation of blood or serum underneath the flap. The slightest bleeding point should be secured by fine forceps, which may be removed after a few minutes. In earlier operations, the error was made of being too conservative with the excision of scar tissue; this is apt to result in difficulties for the flap when attached to the edges of the defect, and recurrence of contractures occurs. The suture line should be laid in healthy skin.

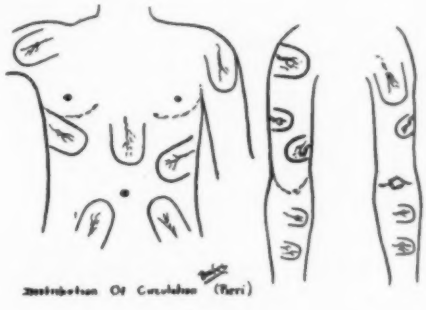


Fig. 1.
Location of Abdominal Flaps. (Pieri)

3. The Adaptation. The flap, which should carry a substantial amount of subcutaneous fat, must be placed without tension, and suturing must be done with the greatest care. The writer uses horse hair preferably, not only because of the very accurate adaptation possible with it, but also because its use precludes any undue tension upon the flap. The introduction of silk or silkworm strands between the sutures and under the flap promotes the drainage of serum and facilitates the contact of the flap with its bed. C. H. Mayo advises scarification of the flap to prevent venous engorgement. Stasis is just as detrimental to the vitality of the flap as is incomplete arterial supply.

4. Immobilization. Absolute immobilization of the pedunculated flap during the period between the first and second step is essential, and in children, as well as in adults, a light plaster bandage over the dressings is of advantage. A window is cut out over the flap to take care of the dressing.

This consists of strips of silk covered with sterile yellow vaseline laid over the wound and covered by gauze. The first dressing is usually done after three or four days, when the strips are carefully changed.

5. Liberation of the Flap. In the pedunculated flap, the time for liberation is given from ten days to three weeks. I prefer to wait for three weeks before cutting the pedicle. Only in exceptional cases when the nutrition of the flaps seems to be especially good, is the pedicle cut sooner.

6. After-treatment. After the flap has completely healed into its new bed one may institute very careful massage in order to promote nutrition in the flap and its free mobility under the underlying tissue. Of much greater importance is the post-operative splinting for the prevention of recurrences. In some cases of finger deformities we have used night splints for years. (Fig. 15.)

1. Finger Webs. In cases of syndactylism, several methods have been applied according to the individual need of the case. The most common has been the method of Didot which consists in the formation of a double trap-door flap, one on the volar and one on the dorsal side, with their bases opposite to each other. This flap method yields a comparatively good amount of skin for the covering of the raw surfaces, and it effectively prevents the reunion of the sides of the separated fingers. The only disadvantage found was that occasionally one does not succeed in preventing the web of the finger from wandering distally toward the mid-phalangeal joints. In order to meet this complication, we have lately employed Tubby's modification. Tubby tunnels the webbed fingers at the metacarpophalangeal junction by means of two small flaps, one raised on the dorsal and one on the volar side, with their bases pointing in opposite directions. These flaps are then drawn through to the opposite side, forming a tunnel which is kept patent by means of a glass rod. After this preparatory step the separation of the web may be carried out by the method of Didot.

In several instances, where the fusion of the third and fourth fingers was complete and the neighboring index fingers contracted, we used a shift flap method, a diagram of which explains the details. In these cases it was thought best to sacrifice one of the fused fingers by removing the phalanges and the metacarpal head, and to use the dorsal integument for the covering of the remaining finger. The volar portion of the skin was made into a flap, which was shifted to the third contracted finger after the latter had been straightened and the contracting scar had been thoroughly removed. It was felt that three good fingers on the hand in this case would be better than four contracted ones. Occasionally a pedunculated flap from the abdomen was used to cover the raw defects in syndactylism when

sufficient skin was not available by either of the foregoing methods. (Figs. 2, 3, 4, 5.)

2. THUMB WEBS. The problem of separating the webbed thumb from

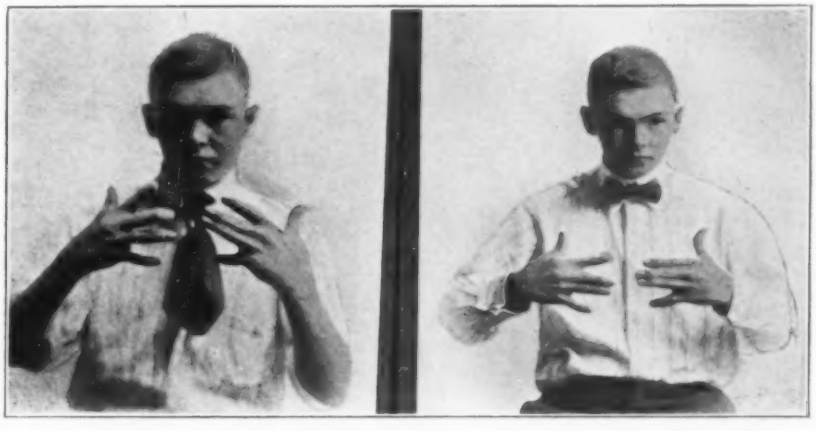


FIG. 2
Syndactylism. Didot's Method.

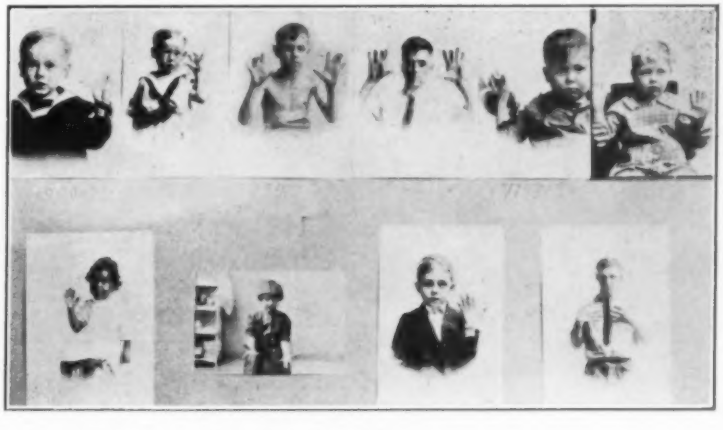


FIG. 3.
Syndactylism. Didot's Method.

the index finger was dealt with in two cases by the method of Pieri. He uses a Z-shaped incision. The middle portion of the incision runs over the crest of the web and of the two extremities; one runs along the side of the

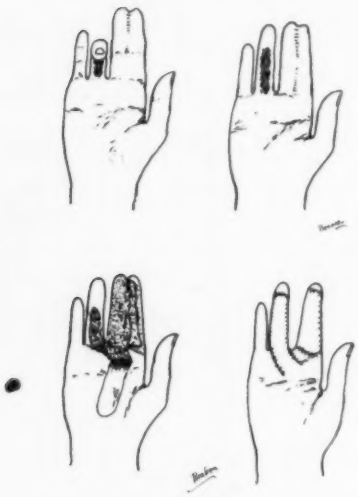


FIG. 4.
Syndactylism. Shift-Flap Method.

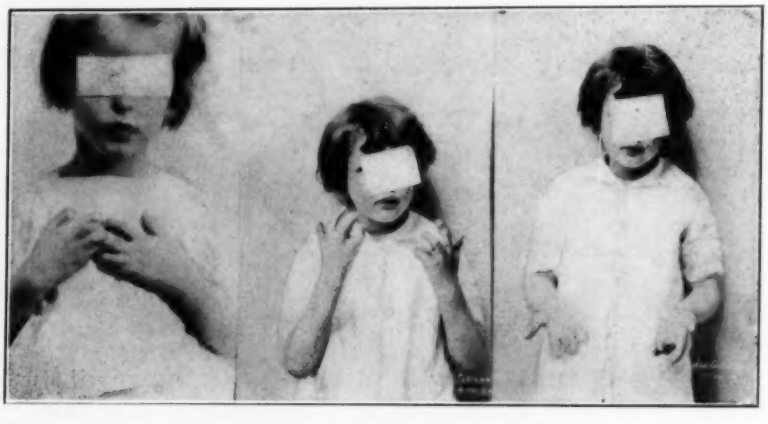


FIG. 5.
Syndactylism. Shift Flap Method.

second metacarpal dorsally and the other on the side of the basal phalanx of the thumb volarly. When these two flaps are separated they make two triangular flaps with their bases at the second metatarsal and the first phalanx of the thumb respectively, and each of these is swung around to cover the raw surfaces. (Fig. 6.)

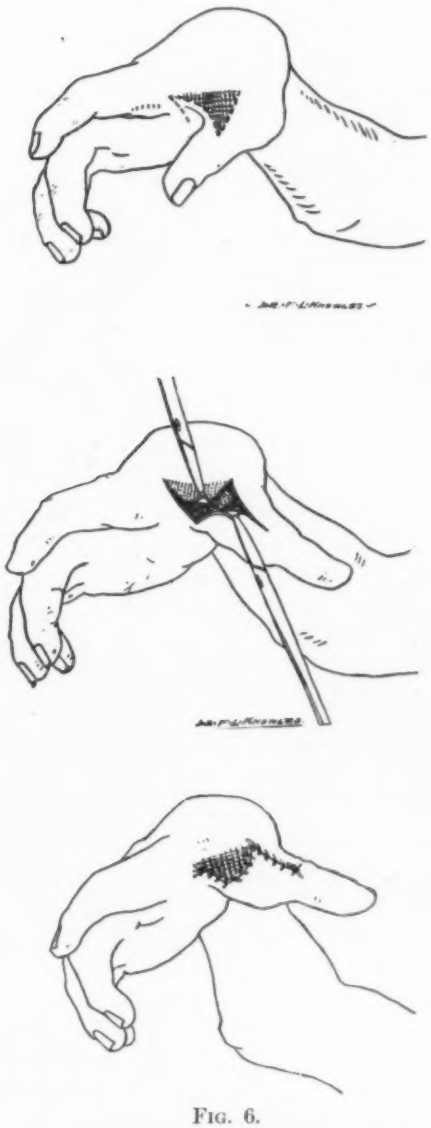


FIG. 6.
Pieri's Method of Thumb Web Plasty.

3. Scar Contracture of Fingers and Palm. These cases were mostly patients with severe gasoline burns or rope burns, leaving very extensive and irregular scars and contracting the palm and fingers. A few cases were congenital contractures. Very extensive resection of the scar is necessary, and it should be carried out beyond the webs of the fingers. When the hand is then straightened, it leaves a defect very much larger than it would appear before operation. In the majority of these cases the

Fig. 7.
Scar Contracture. Fingers and Palm. Italian Flap Method.

Italian method was used with flaps taken from the abdominal wall according to Berger, Murphy, or from the breast according to Morestin. In younger children with abundant fat layer, one must be careful not to leave too much of it with the flap. In some instances the flap turned out too heavy because of the underlying fat layer, and some of it had to be resected subsequently. If the scar resection reaches distally beyond the webs of the fingers, secondary operations are necessary after this has healed in order to reconstruct the finger webs. (Figs. 7, 8, 9.)

4. Dupuytren's Contracture. Operative methods are indicated in all advanced cases, and all newer methods aim at complete excision of

FIG. 8.
Scar Contracture. Fingers and Palm. Italian Flap Method.

FIG. 9.
Scar Contracture. Fingers and Palm. Italian Flap Method.

the palmar fascia. In Tubby's method a longitudinal incision is made, from which by cross incisions flaps are raised and turned back. Transverse palmar incisions are used by Hutchison and Gill with the additional resection of the heads of the basal phalanges after dissection of the fascia. In two cases the writer has used the ulnar flap method of Lotheisen. The resection of the extensive connective tissue strands was carried out by

FIG. 10
Dupuytren's Contracture. Left: After Operation. Right: Before Operation.

raising a long flap from the ulnar side of the hand, under which all strands of connective tissue were carefully isolated and resected. Buttonholing of the flap occurs very easily. One should be careful not to lift the flap too far off toward the radial side; sloughing of the edges occurs very readily. Posterior finger splints were used in the after treatment to maintain correction. All tension upon the scar, all forcible and painful overcorrection was avoided. (Fig. 10.)

5. Burn Contractures of the Wrist. Contractures of the wrist following burns were encountered both as extension and flexion deformities. Here the Italian flap method has been especially useful. The flaps were almost always taken from the upper abdominal region, occasionally from the thoracic region. We have never tried Ombredanne's suggestion of taking the flap from the opposite side of the forearm. In extreme flexion contractures of the wrist the fingers go into hyperextension at the metacarpo-phalangeal joints and in acute flexion in the mid phalangeal joints, often producing trophic ulcers over the latter joints. In one instance, especially, the correction of the flexion deformity contributed greatly to the correction of the finger contractures. However, the dorsal subluxation of the

Fig. 11.
Scar Contracture of Elbow. Italian Flap Method.

metacarpo-phalangeal joints necessitated resection of the metacarpal heads before complete closure of the fingers became possible. (Fig. 9.)

6. Elbow Contractures. Elbow contractures following burns require the extensive resection of the contracting scar and the reconstruction of the cubital space. Berger advises flaps taken from the abdomen and Poncet those from the thorax. Morestin's method consists in the excision of scar and coaptation of the edges of the defect by suture in extreme flexion. In one case treated the abdominal flap gave very good satisfaction, allowing almost complete extension of the elbow. (Fig. 11.)

7. Arm-Chest Adhesions. More difficulty is encountered in the treatment of the so-called arm-chest adhesions. The width and thickness of the web, the firmness, depth, and mobility of the scar tissue and the condition of the skin in the neighborhood determine largely the difficulties of reconstruction.

FIG. 12a.
Arm-Chest Adhesions. Shift Flaps.

FIG. 12b.
Arm-Chest Adhesions. Shift Flaps.

Jobert and Chaput advocate the use of shift flaps taken from the thorax and back, while Défontaine uses anterior and posterior triangles for the reconstruction of the axilla. We have used the shift flap method in one

Fig. 12c.
Arm-Chest Adhesions. Shift Flaps.

instance to reconstruct the axilla, while in another, where the web was wider and more mobile, a Z-shaped flap similar to that used by Pieri was applied. Berger describes a similar method of Z-shaped incision. It seems that this procedure is applicable in wide and thin webs with movable skin,

since the flaps consist largely of scar tissue. The important point is the reconstruction of the axilla, which may be done either by shift flap or anterior and posterior triangles. In dressing these cases it is not necessary,

FIG. 13.
Arm-Chest Adhesions. Shift Flaps.

nor is it advisable, to apply extreme positions. Tension of the newly formed flap should be carefully considered and, if necessary, full abduction may be attained in steps. (Figs. 12a, b, c, 13.)

8. NEOPLASTY. For the neoplasty of the missing thumb several methods are available. The method of Nicoladoni consists in the exchange

of the missing thumb by the big toe of the other foot and he has reported two cases with excellent results. Joyce, Mannasse, Riedel, and Öhlecker have used a method of finger exchange by use of the fourth finger of the

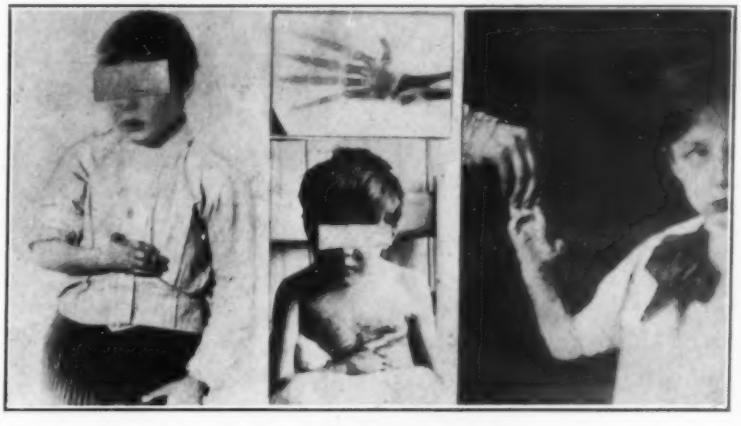


FIG. 14a.
Neoplasty of Thumb.

FIG. 14b.
Neoplasty of Thumb.

left hand implanted upon the base of the missing stump. Pieri uses the method of phalangization by separating the metacarpal of the thumb from that of the index finger and enveloping both sides by means of Z-shaped

FIG. 14c.
Neoplasty of Thumb.

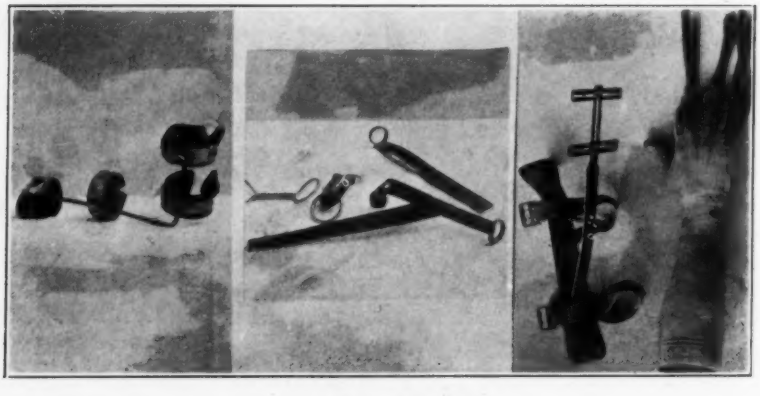


FIG. 15.
Some of the Splints Used in Postoperative Treatment.

flaps described. Klapp, Lyle, Verall, and Wierzejewski have reported cases successfully operated upon by this method.

A third method is that of a flap taken from the chest and made into a roll of skin by suturing the long edges to each other. A piece of the rib or a graft from the tibia (Albee) is implanted into the roll. The operation is completed in two or three steps, (Albee, Ritter, Schepelman).

One case of congenital defect of the thumb was operated upon by the writer in the manner described. A flap was taken from the thorax of the opposite side, and a piece of the rib separated and imbedded in the flap. At the same sitting the free end of the flap was implanted into the prepared bed of the missing thumb. Liberation of the flap was carried out after twenty days. (Figs. 14a, b, c.)

SUMMARY

Forty-seven extremities were operated upon by the various flap methods on forty patients.

		Results	
		Good	Poor
1. Syndactylism	14 hands	8 = 57%	6 = 43%
2. Thumb webs	6	5 = 83	1 = 17
3. Contractures of fingers and palm	17	7 = 41	10 = 59
4. Dupuytren	2	1 = 50	1 = 50
5. Contractures, wrist	4	3 = 75	1 = 25
6. Elbow web	1	1 = 100	——
7. Arm-Chest	2	2 = 100	——
8. Neoplasty	1	1 = 100	——

Analyzing the causes of failures in groups 1 and 3 (syndactylism and palm and finger contractures), the only ones large enough to permit of conclusions, there were errors in judgment as well as in technique. Errors in judgment occurred chiefly in the selection of local flaps, shift flaps, etc., when pedunculated flaps after the Italian method would have been better. Errors in technique consisted mostly in undersizing of the flaps when pedunculated, in undue tension of local flaps, and in allowing wound secretion to accumulate under the flaps, and in formation of bases of flaps too narrow for adequate nutrition. Since all these points were given due regard in later operations the operative results have become much more satisfactory.

CONGENITAL DEFECTS OF THE LONG BONES OF THE LOWER LIMB

A Contribution to the Study of Their Causes, Effects, and Treatment

BY ROBERT OLLERENSHAW, M.D., F.R.C.S. (ENG.), MANCHESTER, ENGLAND

Orthopaedic Surgeon to the Royal Manchester Children's Hospital

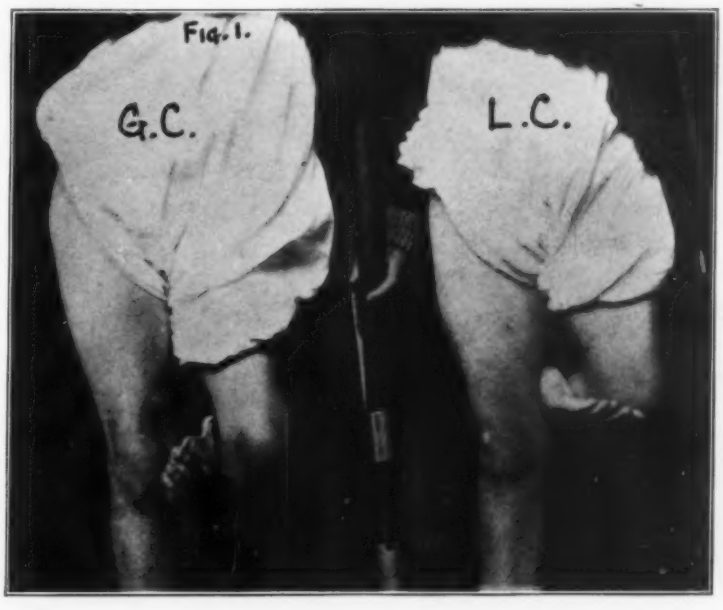
The problems presented by the congenital defects of the long bones are many and varied, and it is important that those of us who have to deal with a constant succession of these cases should make every endeavour to facilitate the solution of the problems by complete investigation and careful record. The various therapeutic measures which have been from time to time employed differ, of necessity, with each individual case and with the inclination of the surgeon. Investigation of eleven cases which have come under my care, chiefly at the Royal Manchester Children's Hospital, during the past few years, has brought out many points of interest to the surgeon and embryologist. I propose to refer, in some detail, to two cases of deficient femur, two of congenital absence of the fibula, three of absence of the tibia, and one of "congenital amputation" through the leg. None of these cases has been previously reported.

It is taught that defects in the extremities may be due to failure in the inherent power of growth of the germinal matter which forms these parts, or to mechanical interference from without. My investigations have led me to the conclusion that the latter factor, mechanical interference, has nothing at all to do with deficiencies in the long limb bones.

The predominant cause is undoubtedly a cessation of growth in one or other set of embryonic cells at a period between the fourth and sixth weeks of foetal life. The cause of the arrest of growth is quite unknown.

It has for long been the custom to ascribe limb defects to amniotic bands, constrictions caused by umbilical cord and the like. The theory is an easy one to assimilate, and occasionally constrictions which appeared to be the certain result of cord pressure have been observed on arms and legs. I have been fortunate enough to come across two cases where such so-called "cord constriction" was present on leg and foot, and yet both hands and both feet showed defects or excesses of metacarpals and phalanges, multiple lesions which could not possibly be ascribed to cord or

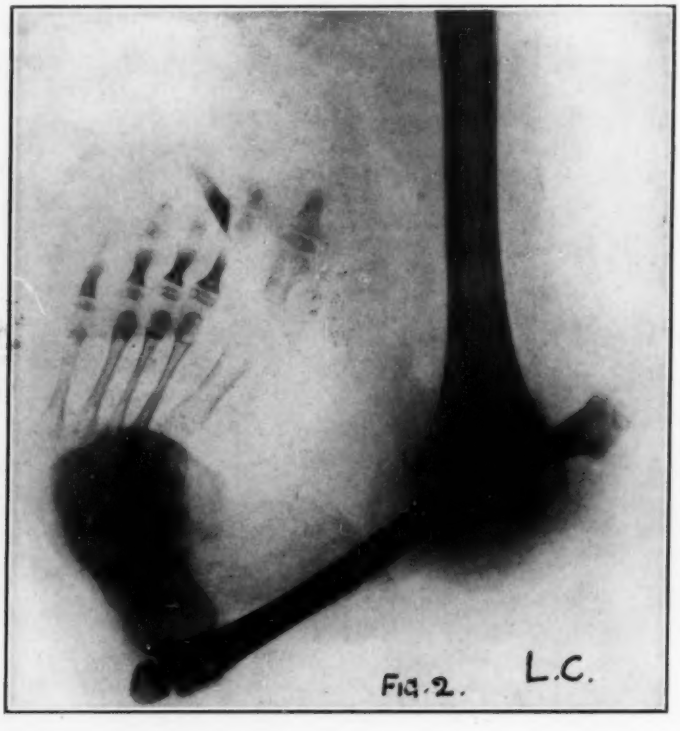
amniotic bands. It seems more than likely that the so-called constrictions are not constrictions at all, but merely one of the results of the interrupted limb growth. Then again, although it is conceivable that a one-sided deformity might be caused by pressure from without, when we meet with the deformity as a symmetrical condition on the two sides, or in twins, we must presume a failure in growth of limb material and we are bound to discard the theory of local injury. Further, the severer conditions known as amelus, in which the defective limb is simply represented by a bud,



peromelus, in which four defective extremities exist, and phocomelus, in which well formed hands and feet are attached to the trunk without any intervening limb, all the long bones being absent, are obviously not due to mechanical cause, but to cessation of growth in the limb buds.

The theory of violence, such as results from a blow or a fall, as a cause of congenital limb defects has often been put forward, but it cannot be taken seriously. The foetus floats in a medium of almost its own specific gravity and well surrounded by other organs. It is hardly conceivable that violence which could interfere with the individual foetal bones and muscles should not produce abortion. Further, it must be remembered

that not only the bones, but the individual muscles of the foetus, are recognizable and well differentiated from the stage of general muscle-mass at six weeks, so that local violence which is to produce a long bone defect with which certain definite muscle abnormalities are associated must act before the muscles are normally laid down and at a time when the foetus measures only three or four centimetres.



Every long bone of the extremities save the humerus has at some time or other been reported absent or deficient. The bone most commonly affected is the fibula; then follow in order the tibia, ulna, and radius. The femur has very rarely been reported absent or defective.

Cases 1 and 2. Absence of Tibia in Identical Twins.

The rarity of absence of the tibia may be judged from the fact that Hoffa, in a survey of 9,877 cases of congenital deformity, found that 2,425 affected the lower limb, and not one case of absence or deficiency of the

tibia was found in this series. Nuzzi in 1920 found that 81 cases of deficient tibia were on record. The first was reported by Otto in 1841; from that date to 1901 forty cases had been recorded, and from 1901 to 1921 a further forty-one were described.

L. C. and G. C. are the twin daughters of healthy parents. They are the eleventh and twelfth children of the family, all the preceding children

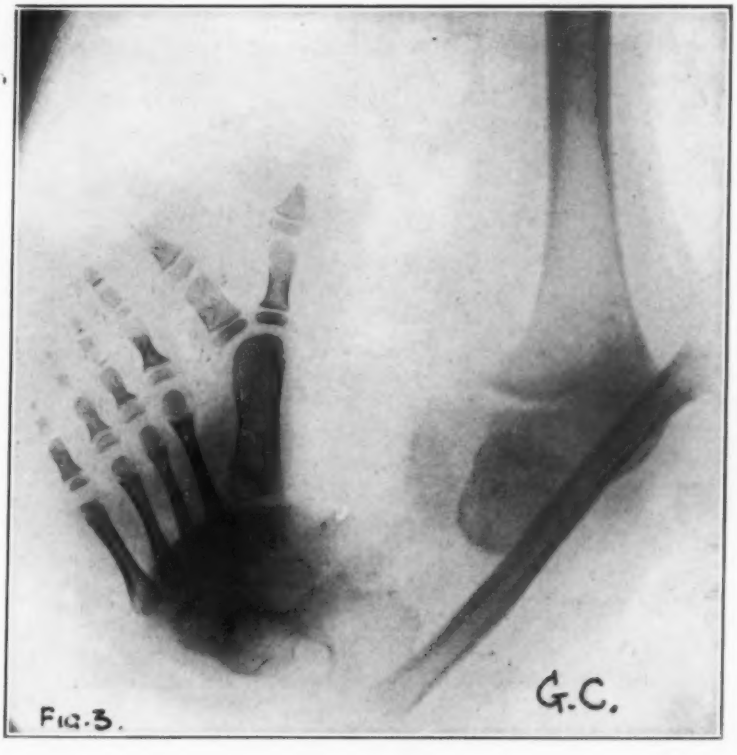
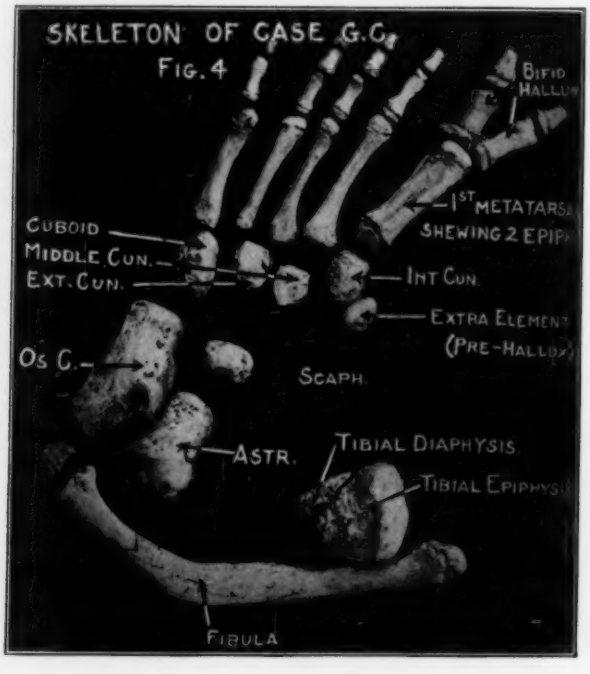


FIG. 3.

being entirely normal. The parents show no abnormality. There is no history of syphilis, and the Wassermann reactions of both parents and children are negative. The mother suffered no injury during the pregnancy. The children are completely normal save for the left lower extremity which in each case shows a normal thigh passing in a rudimentary leg which is so greatly stunted and curved in a varus direction that the sole of the foot looks upwards and inwards towards the perineum. (Figs. 1, 2, and 3.) The two children present as close an identity as can well be imagined.

They are of the same sex, absolutely similar in features, skin, hair, and colour of eyes and are so identical as to have reproduced an extremely rare deformity. The degree of deformity was so great that nothing save amputation was possible in the way of treatment, and I amputated both through what would have been the knee joint had the tibia been present. They were later fitted with a pylon leg which will be replaced by a more elaborate fitting when they are older. These amputations gave us two



valuable specimens. One of them was dissected and preserved to show the muscular arrangements. The other was prepared as a specimen of the bony skeleton of the limb.

SKELETON OF G. C. LIMB (Fig. 4.)

In this preparation attention is specially drawn to the following points:

1. Very large fibula, half as thick again as a normal fibula at this age, and yet it has never carried weight. The increase is partly due to the muscle traction and is partly nature's attempt to make up for absence of the tibia.

2. Upper epiphysis of tibia is about normal size.
3. Presence of a trace of diaphysis.
4. Double hallux. The association of polydactylism and long bone defects is quite remarkable.
5. The hallux metatarsal shows both proximal and distal epiphyses, an occurrence seen occasionally in normal feet.
6. An extra element lying alongside the internal cuneiform. It is quite different from the extra scaphoid appendage, the "os tibiale externum."

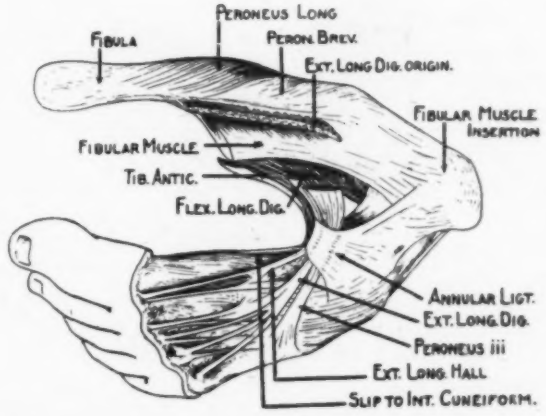


FIG. 5 EXTENSOR ASPECT

Anterior View (Extensor Aspect) (Fig. 5).

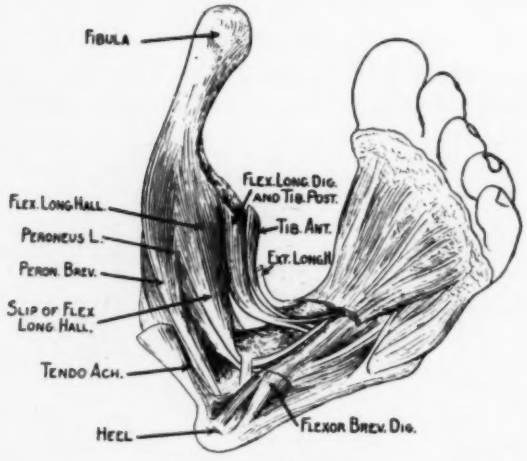
Dissection of Amputated Segment L. C.

Mr. Sewell has made semidiagrammatic drawings of this dissection. The musculature left after the flaps were cut at amputation was difficult to dissect, but the drawings show that the muscles are such as one would expect in the absence of a tibia but that there is a muscle lying deeply between the hypertrophied fibula and the diminished tibial muscles which has both its origin and insertion in the fibula. This muscle is as thick as an adult finger and is quite a healthy looking muscle, yet it cannot possibly have done work. Sir Arthur Keith, who has kindly examined the specimen, regards this as the tibio-fibular muscle, which is usually a vestige in the human leg.

Note: 1. Normal foot tendons.

2. Diminished tibial muscles.

3. Abnormal muscle — ? Tibio-fibular.



Posterior View (Flexor Aspect) (Fig. 6).

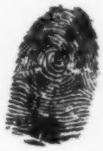
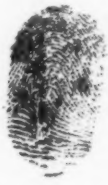
1. Normal appearance of muscles in view of absent tibia.
2. Tibialis posticus and flexor longus digitorum apparently fused, but tibialis posticus definitely present.

The similarity between these two children was so extraordinary that it seemed likely to extend even to the arrangement of the papillary lines of the hand and fingers and, as it has been stated that no two persons show precisely similar arrangement of the dermal ridges, sets of finger prints were taken. These, when suitably enlarged, showed that the two children could be quite easily identified and it will be seen at once from Figs. 7 and 8 that the right index of G. C. shows a well-marked "whorl" type whilst the right index of L. C. shows an equally well-marked "loop" formation. This alone is, of course, sufficient to identify the two individuals, and it would appear that even the most closely identical twins, showing no points of difference on close general examination, do not carry the similarity so far as to reproduce the dermal patterns.

CASE 3. ABSENCE OF TIBIA WITH DEFECTIVE FEMUR.

The specimens which hitherto have been available for closer examination by dissection have been parts removed by amputation at a level where the knee joint would have existed in a normal limb. The structures of the upper third of the leg were therefore always damaged and not easy to identify.

RIGHT HAND

1.—Right Thumb.	2.—R. Fore Finger.	3.—R. Middle Finger	4.—R. Ring Finger	5.—R. Little Finger.
				
(Fold.) Loop ⌊	Whorl	Loop ⌊	Loop ⌊	(Fold.) Whorl

LEFT HAND

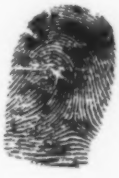
6.—L. Thumb.	7.—L. Fore Finger.	8.—L. Middle Finger.	9.—L. Ring Finger.	10.—L. Little Finger.
				
(Fold.) Loop ∫	Loop ⌊	Loop ∫	Loop ∫	(Fold.) Central Pocket

FIG. 7

I counted myself very fortunate, therefore, when a dead full term child with absent tibia came to hand. (Figs. 9 and 10.) A very careful dissection was made of the whole limb by Dr. W. H. Wood of the Anatomical Department of Manchester University. The result of this dissection has been to show that all the normal muscles are present but are changed in course and in insertion in degree proportionate to their normal association with the tibia. For example, the long thigh muscles which normally insert

into the head of the tibia (semimembranosus, sartorius, etc.) take the shortest route across the bowed limb and insert into a fibrous mass which becomes incorporated with the posterior ligament of the knee joint. Every muscle can be identified, but in the deepest of the muscular layers in the posterior tibio-fibular compartment lies the muscle which in the previous

FIG. 8

case I referred to as the tibio-fibular muscle and which is also present in another specimen of the Royal College of Surgeons collection.

This muscle occupies a position in which one would expect to find the tibialis posticus, and as this muscle is not among those already identified, it must, I think, be labelled as an abnormal tibialis posticus. It originates from the fibula and from the fibrous prolongation downwards of the semimembranosus insertion. This fibrous slip I regard as the only representa-

tive of the missing tibia. The muscle is inserted into the lower end of the fibula on its inner surface. In the sole of the foot there was no trace of a tibialis posticus tendon, and it would seem that this muscle, which corresponds in position to the muscle described in the previous case, and named "tibio-fibular," must be looked upon as an abnormal tibialis posticus.

FIG. 9

Note. Six Toes — extra hallux. Hypertrophy of penis: imperfect anus also. Foot has been turned out; plantar surface faced the perineum.

The photographs of the dissection (Figs. 9 to 17) explain much better than words the exact arrangement of the muscles. In the dorsum of the foot (Fig. 17) the common reduplicated hallux will be seen. The only tendon running to this accessory toe was a very small slip from the extensor brevis digitorum.

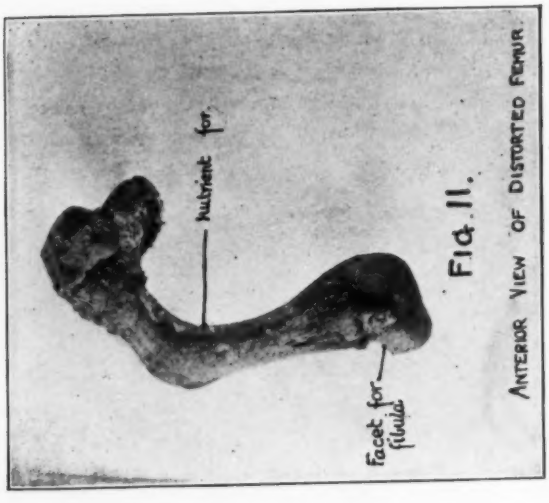


FIG. 11.
ANTERIOR VIEW OF DISTORTED FEMUR.

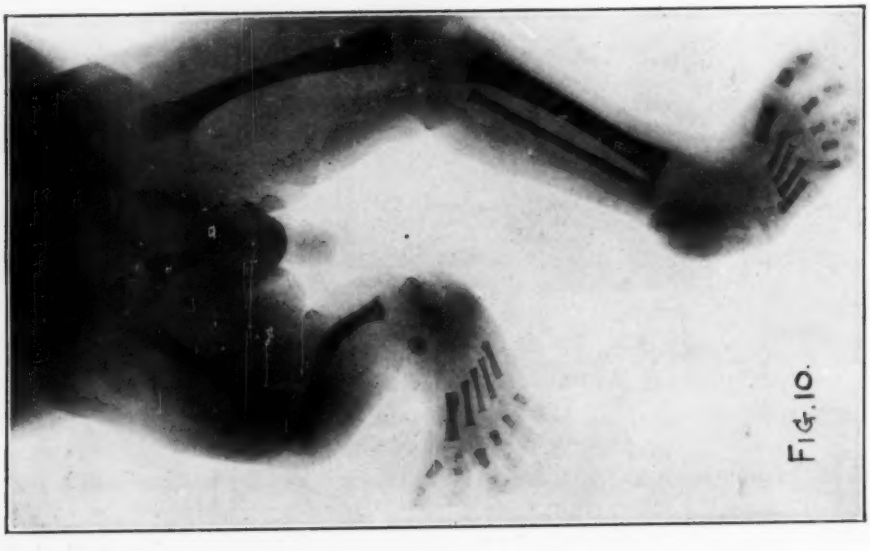


FIG. 10.

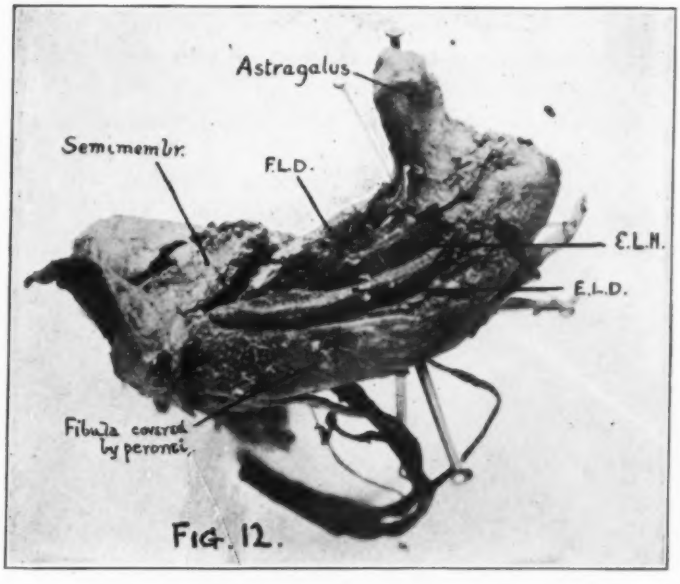


FIG. 12.

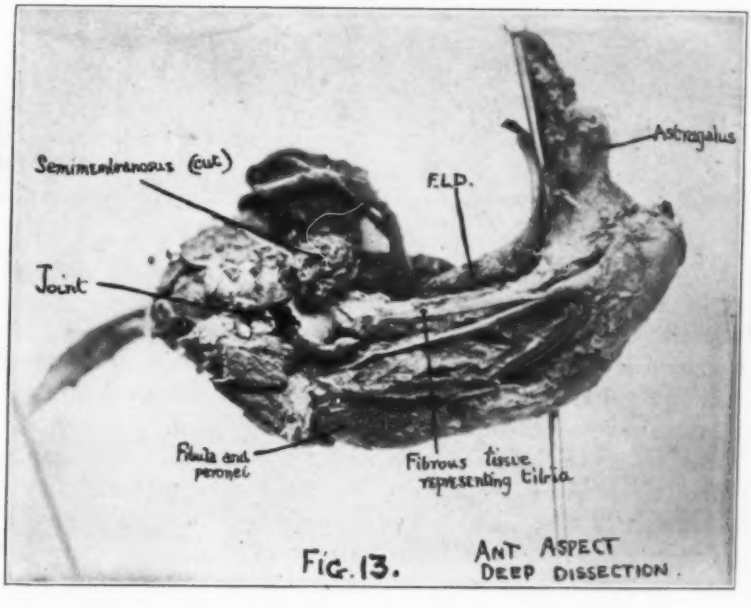


FIG. 13. ANT ASPECT DEEP DISSECTION.

TREATMENT. In the more severe cases it is rare that surgery can effect much, if any, improvement in the very defective limbs, and operations under these circumstances are forlorn hopes. In such patients a well planned amputation, saving all of value, is the only solution. When this procedure has to be adopted it is an advantage to amputate during childhood. Every one knows how quickly a child will adapt itself to a walking caliper or to some form of pylon, and such an individual will be very proficient in later life in the management of a more elaborate artificial limb. In cases where there is no extreme shortening and no gross deformity it is

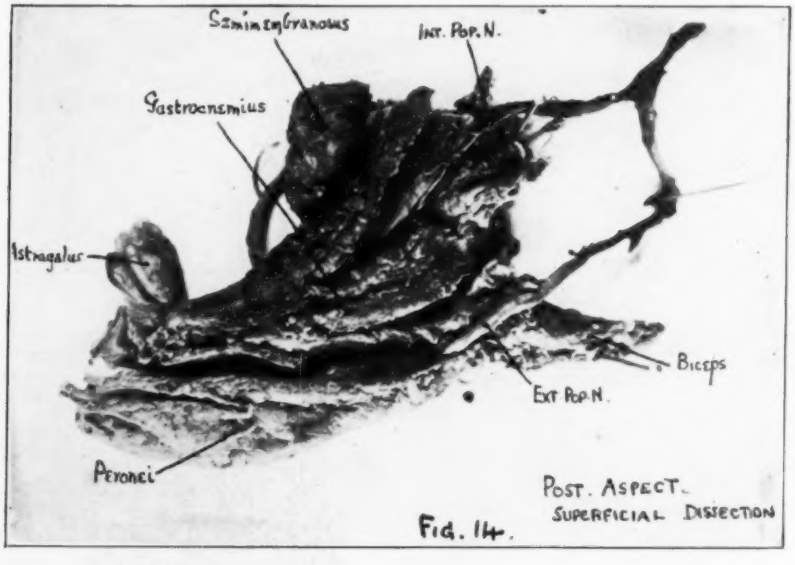


Fig. 14.

possible by judicious division of fasciae, tendons, or bones, accompanied sometimes by a bone-graft, to bring about considerable improvement in the function of the limb.

Congdon has reported an instance of bilateral deficiency of the tibia, with moderate deformity, in which he was able to introduce a series of grafts from the femora. In this case, before operation, the child was just able to walk with the help of braces with the feet in a varus position. As a result of the treatment the braces were dispensed with and the talipes largely corrected. Gaenslen, in a paper written in 1914, gives a very complete survey of the subject and describes two of his own cases, one of tibial deficiency and one of absence of the fibula. In the former case a stabiliza-

tion of the knee was obtained by a bone graft wedged from femur to fibula. This operation, which was done on only one side, certainly effected a considerable improvement in the limb.

CASE 4. DEFECTIVE FIBULA.

This condition is not associated with such severe deformity as is the case in absence of the tibia, and as a rule simply amounts to a shortening of

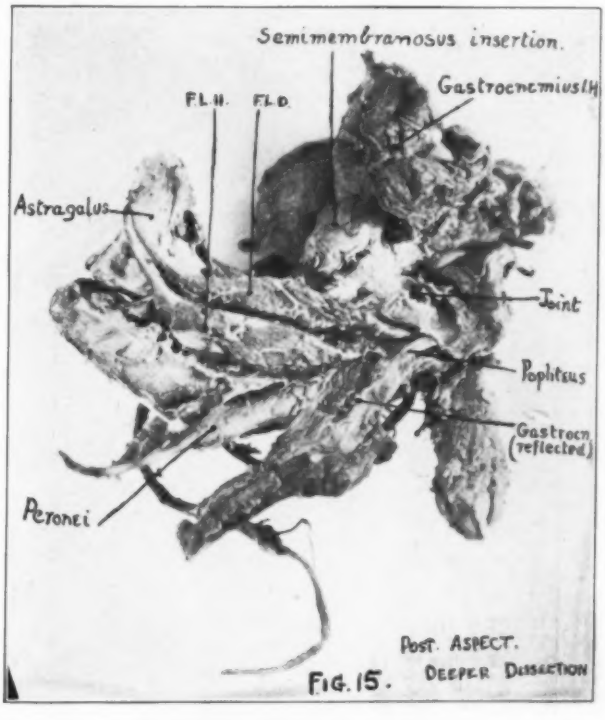


FIG. 15.

the limb segment with the associated valgus deformity. In many cases there is forward bend of the tibia at the junction of lower and middle thirds and often a dimple in the skin over the apex of the bend (Figs. 18, 19 and 20). By some this has been called a cicatrix, but there is no evidence that such is the case. Much can be done to improve these limbs by carefully planned operative measures and I have dealt in this way with three cases.

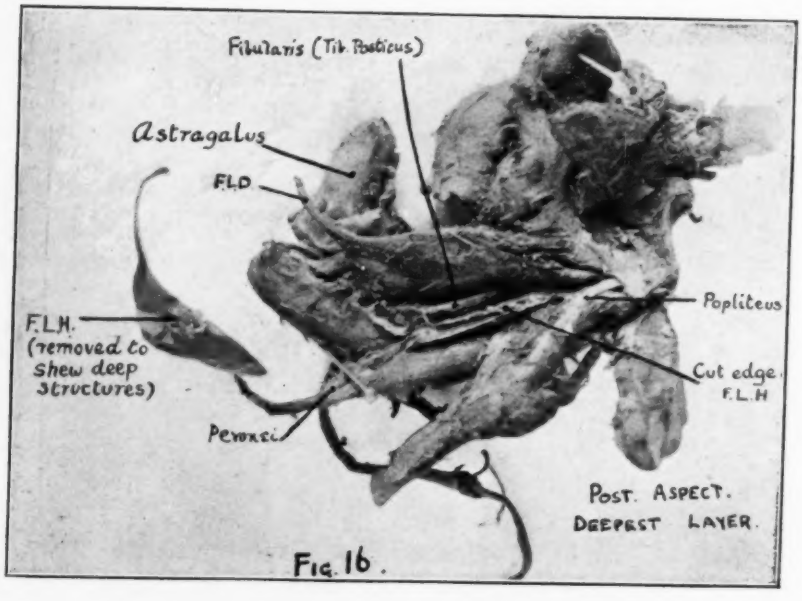

Fibularis (Tib. Posticus)
Astragalus
F.L.D.
F.L.H.
(removed to
shew deep
structures)
Peronei
Popliteus
Cut edge
F.L.H.
Post. Aspect.
Deepest Layer.

Fig. 16.

Supernumerary digit which received a
small slip from E.B.D. only.
E.L.H.
E.B.D.
Transuersa Lig.
(Ant. Annular.)
Dorsum of
Foot.

Fig 17

FIG. 18

FIG. 19

FIG. 20

CASES 5 AND 6. DEFICIENT FEMUR.

This is an extremely rare deformity, very little information being available on the subject. In the most recent text book on orthopaedic surgery the matter is referred to, but merely to state that the experience of the author is slight and that operative treatment must have a limited scope.

FIG. 21

FIG. 22

Case 5 is a boy of eight years who has a short femur on the right side, the rest of the limb being normal. Two and a half inches of shortening are now present, so that by the time full growth is attained there will probably be four or five inches difference between the two femora. (Figs. 21 and 22.) Skiagrams show a short thick femur with a coxa valga condition in the femoral neck and an altered shape of the lower epiphysis. The knee-joint movement, however, is normal and the patella is present. The tibiae and fibulae as shown are equal in length (Figs. 23, 24). As to the question of treatment, the next case helps, I think, in coming to a decision.

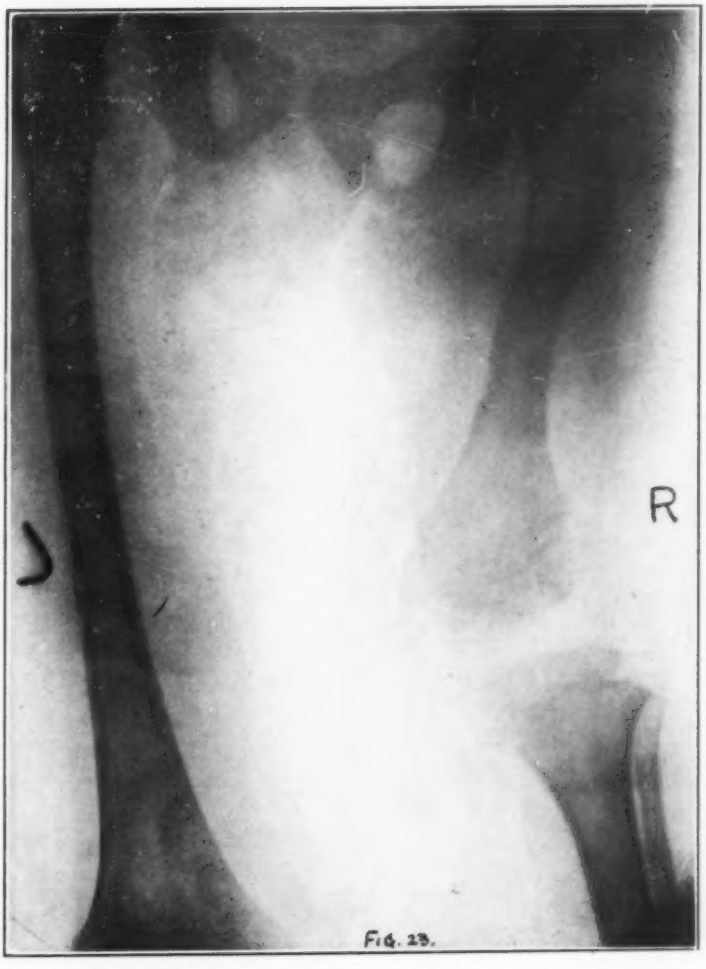
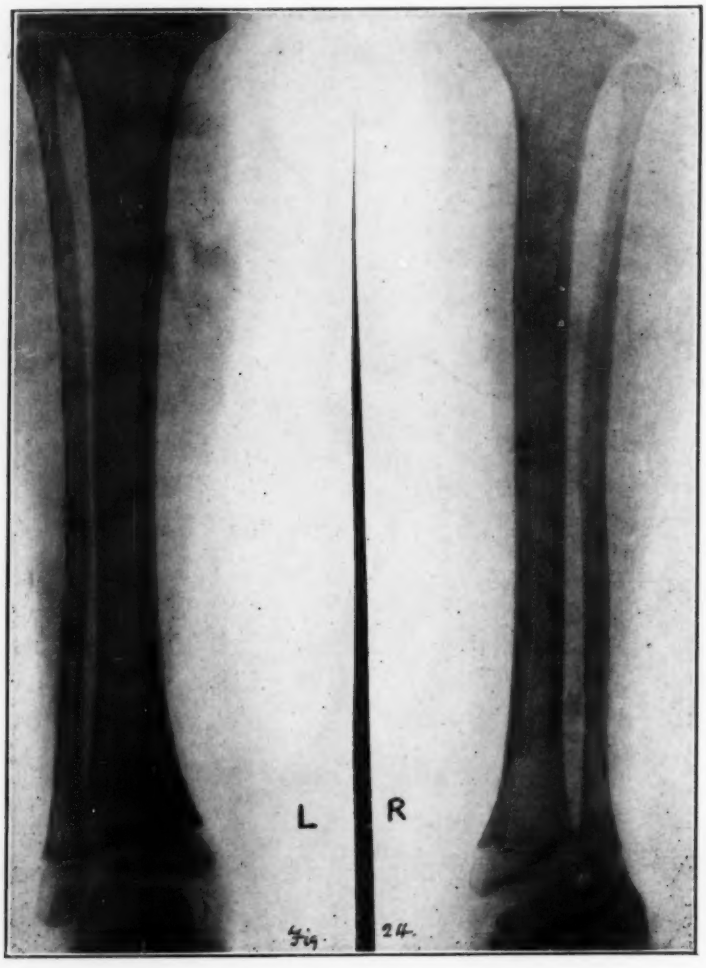


FIG. 23.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R
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24.

CASE 6. DEFICIENT FEMUR.

A young woman, aged 17 years, came to me with a very severe limp, due to four and one-half inches shortening of the left thigh.

The history was that the leg had always been short, and skiagrams showed the defect (Fig. 25). This illustration is a composite roentgeno-

FIG. 25.

FIG. 26.

gram made from several films. Here, again, is seen the short and thick femur. The rest of the limb was normal and I decided to make an attempt to equalize the two femora in length. I first exposed the shaft of the defective bone, divided it transversely and had strong traction applied. After a pull of some minutes a gap of one and a half inches was obtained. The

pull was then relaxed and I exposed the normal femur and removed a piece one and a half inches long from the middle of the shaft. This piece was taken care of and the shortened femur fixed together by a Lane plate. Trac-

FIG. 27

FIG. 28

FIG. 29

tion was again applied to the short leg and the removed piece was then inserted in the gap and the whole fixed by another Lane plate, the screws of which took hold of upper and lower fragments and graft. The limbs and

FIG. 31

FIG. 32

trunk were then enclosed in a plaster cast to ensure as complete fixation as possible.

The result has been satisfactory and the girl is now getting about with only one and a half inches difference between the two legs. Fig. 26 shows her present appearance. The X is placed over the anterior superior spine

FIG. 33

of each side. I contemplate, therefore, some similar interference in the case of the boy referred to above (Case 5).

I wish now to refer to some cases exhibiting so called constrictions from cord or amniotic bands. The first is a boy of seven years, who is said to have had the umbilical cord wrapped round his legs and arms. The right leg (Fig. 27) would strongly suggest this possibility, but the feet show defi-

cient toes (Fig. 28) and the hands show defects, the left hand showing an uncommon deformity, the proximal phalanges of ring and little fingers lying enclosed in one segment of a digit which represents the fused fourth and fifth fingers. A dimple is present over the gap between them. Beyond that point is a single second phalanx and a single terminal phalanx (Figs. 29 and 30).

The next case illustrates a similar "cord mark" in a boy with many deficient toes and who also had double club foot, for which tarsectomies had been done by my predecessor (Figs. 31 and 32).

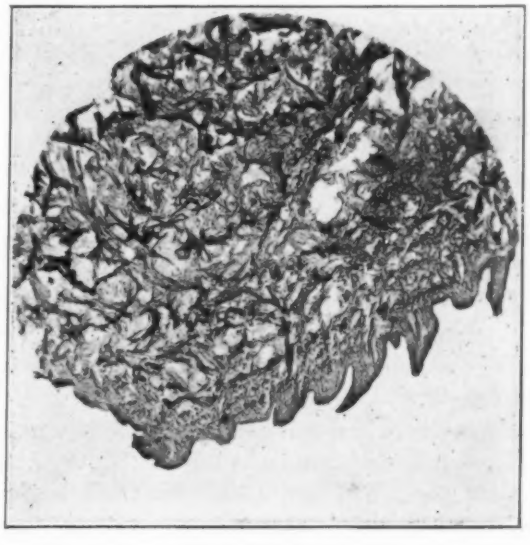

FIG. 34

The last case is one of a boy aged twelve who, in addition to many defects of fingers and toes, had what is known as a congenital amputation of the right leg, a condition ascribed to strangulation of the limb by amniotic adhesions or cord (Fig. 33). In view of the multiplicity of the lesions in this case, the cord theory seems impossible. As I had to trim off the stump because the tibia and fibula, which were fused at their terminal extremities, were growing too long for the coverings, I took the opportunity of examining the bone and the coverings for evidence of scar tissue, which must necessarily be present if a limb has been amputated either by design or by misadventure. I was unable to find any trace of scar. Figure 34 shows

a microphotograph of a section of the skin from the end of the stump. It was stained by van Giessen's stain, and the striking element is the large amount of yellow stained elastic tissue which is, of course, absent in all scar tissue.

The dermal papillae are larger than normal; the epidermis has come away and lies outside the field shown in this slide. Obviously there has been no cicatrisation in this case.

CONCLUSIONS

1. On the evidence of this series of cases I would suggest that the congenital defects of long bones have no connection at all with outside pressure, but are due solely to interference with growth in the limb buds during the first few weeks of foetal life.

2. Deformities associated with defects of the fibula are usually not so severe as in the case of femur or tibia and it is generally possible to effect improvement by operative and mechanical means.

3. Deformities associated with absence or defect of the tibia are generally very severe, and usually amputation alone is possible.

4. Associated with absence of the tibia are many serious alterations in the muscles, but chiefly such as would be expected under such conditions.

There is, however, a strong tendency to persistence and often hypertrophy of a muscle which arises from the fibula and inserts into the same bone. This may be the vestigial tibio-fibular muscle or it may be a very abnormal tibialis posticus. The latter possibility is strengthened by the absence of the tendon of that muscle in the sole.

5. Defects of the femur are usually associated with a normal, or nearly normal, lower segment, and in these cases operation devised to equalize the length of the two femora is well worth consideration.

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EPICONDYLITIS

BY RALPH M. CARTER, A.B., M.D., F.A.C.S., GREEN BAY, WISCONSIN

In the past few years I have seen fourteen cases of a condition characterized by extreme tenderness on pressure over the lateral epicondyle of the humerus, the pain frequently being referred down the forearm to the hand and fingers. With this pain is associated a weakness of the grip, especially in forcible grasping of an object; objective findings are conspicuous by their absence. To this condition, the term "epicondylitis" has been applied.

Epicondylitis humeri is variously known as tennis elbow, epicondylalgia, radiohumeral bursitis, sportsman's elbow, musician's palsy, etc. If we are to judge by the paucity of articles concerning it in the literature, particularly English and American literature, it would seem to be either a rare disease or of insufficient importance to deserve discussion, the latter assumption being borne out by the fact that several textbooks of surgery consulted bear no reference to it.

Now, judging from my own limited experience, which is confined to the cases occurring in a fairly large general and industrial surgical practice, I believe it to be a relatively common affection, and I believe that it is important, both from the standpoint of the general practitioner and from that of the industrial surgeon.

It is important from the standpoint of the general practitioner because he will be consulted by patients suffering from the condition and seeking relief. He should be familiar with it in order that he may recognize it when he sees it, and promptly apply the main principle of treatment, — namely, rest. It is also worth something to be able to reassure the patient by explaining the relative harmlessness of the condition.

It is important from the standpoint of the industrial surgeon, since, from the mode of onset and nature of the disease, claims for compensation may easily arise and frequently be entirely unjustified. This can be determined only after taking a very careful history. On the other hand cases may arise as a result of employment. Under such circumstances, early proper treatment will shorten the period of disability. Likewise, a study of the occupation in which such cases occur may be undertaken, with a view to the prevention of future cases.

According to Bergmann,[1] and so far as I have been able to ascertain from a fairly extensive survey of the available literature, we find the symptom-complex later known as epicondylitis first mentioned in an article by Runge[2], in the year 1873. This article, as is seen by the title, deals with the subject of writer's cramp, and a number of cases are discussed. Among them one is especially mentioned in which there was no history of excessive writing, and which was characterized by pronounced pressure pain over the lateral epicondyle of the humerus. The next paper of importance on this subject is one by Bernhard,[3] in 1896, in which the disease is first considered as a definite clinical entity. In this paper it is stated that Remak had previously written on the subject. According to Bernhard's view the condition was an occupation neuralgia, since the majority of the cases coming under his observation occurred in handworkers in certain trades. Since these contributions were published in neurologic journals they did not attract widespread attention. A little later, however, articles on tennis elbow and musician's palsy by Bähr,[4] Clado,[5] and Preiser[6] appeared in journals of more general distribution, thus calling the attention of the profession at large to the condition. The same is true of the articles of Vulliet[7] and Franke.[8] Since 1910, a number of excellent contributions to the subject have appeared, both in this country and abroad, especially worthy of mention being those by Coues,[9] Osgood,[10] Dubs,[11] and Bergmann.[1] Others will be noted later.

As is shown by some of the designations given to the condition, it frequently follows the activities of certain sports, particularly tennis and fencing; but these cases constitute only a small number. The continuous use of a hammer or a screw-driver, the wringing out of clothes by hand by laundresses, and many other manual activities apparently give rise to it, especially in conditions in which the same movements are repeated over and over. Any occupation requiring the frequent repetition of the combined movements of flexion and supination of the forearm seems to be especially favorable for its development. In spite of this, and contrary to what we might expect, it does not appear as an outstanding industrial disease or injury, if we except those cases appearing in lead-workers. These have a definite etiology, are an expression of lead-poisoning, and are outside the scope of this paper. Certainly epicondylitis as we usually see it is not confined to workers in certain trades, as Bernhard's[3] observations led him to conclude. According to Bergmann,[1] v. Goeldel,[12] and others, it is three or four times as frequent in women as in men, and such has been my experience. Of my fourteen cases, nine occurred in women engaged in the usual duties of a housewife. Three-fourths of the

cases occur between the ages of thirty and fifty. Children are practically never affected, although a case has been reported in a boy of fourteen.

Pain constitutes the most prominent feature of the symptomatology, and such pain displays several characteristics. In most cases, the exact time of its first appearance, or the particular trauma originating it, cannot be definitely fixed by the patient. His pain finally becomes so severe that it constitutes at least a distinct discomfort, if not an actual disability, and it occupies his attention. Upon thinking it over he realizes that for some time past he has had some aching and discomfort in the elbow, transitory in character, of momentary duration, and at first at infrequent intervals and associated with sudden and unusually severe muscular activity of the forearm and hand. He further realizes that these intervals have been growing shorter and shorter, that lately the pain is excited by the most ordinary muscular activity, and that it is now so annoying that it cannot longer be disregarded. Under these circumstances it is impossible for him to fix the exact time of its appearance. This is the history of most cases. On the other hand, there is a small number in which the onset is definitely associated with a well-remembered trauma or muscular effort.

This pain has a peculiarly unpleasant, somewhat sickening quality. In all but the most severe cases it is entirely absent when the arm is resting quietly and is not in use, but it is excited readily by moderate pressure over the region of the external epicondyle of the humerus, which is distinctly tender. Frequently it is referred down the forearm to the hand and fingers. It is also excited by movements of the hand and wrist, particularly by the combined movements of flexion and supination, as they are used in wringing out clothes in washing; also by the movements utilized in tennis and fencing. It is excited by forcible clenching of the fist; by forcible extension and flexion of the hand, especially against resistance. The lifting, and especially the carrying of a moderately heavy weight, as mentioned by Osgood,[10] readily gives rise to great discomfort. With the pain is frequently associated a marked weakness of the forearm and hand, appearing suddenly when an attempt is made to lift objects; this may be so pronounced at times as to amount to an actual, temporary paresis of the muscles, particularly the flexors.

In very severe cases, the pain may appear spontaneously, and a feeling of weakness and lameness in the forearm be constantly present.

In right-handed individuals the lateral epicondyle of the right humerus is affected almost without exception, although occasionally the medial one may be attacked, and very rarely both. In left-handed individuals, the disease appears in the lateral epicondyle of the left humerus. Bergmann[1]

mentions one case in which the affection, after appearing first on the right side, began also on the left.

Objectively demonstrable findings are conspicuous by their absence in practically all cases. All authorities seem to be agreed upon this point, although Osgood[10] has noted slight fullness over the tip of the epicondyle in some cases, and Bergmann[1] gives an illustration of one case showing a most pronounced swelling in this region. He states that this is the only case in which he has observed it, out of an extensive series. I have never noted anything abnormal upon inspection in any of my cases. It might be expected that any swelling, when present, would appear in the recent cases, but such is not the fact; when it has been observed it has been in chronic cases.

In most cases, particularly the recent ones, the roentgenogram reveals nothing abnormal; this is so stated by the majority of writers on the subject, and is entirely true according to my experience; Bergmann[1], however, is not entirely in accord with this view.

Turning now to a consideration of the pathologic anatomy and mode of origin of the condition, we find a number of different theories and explanations, and as is usually true under such circumstances, no one of these, apparently, is applicable to every case.

According to Preiser,[6] the condition arises in the following manner: In the neighborhood of the external condyle and the ligamentum collaterale radiale, fibers of two functionally different muscles are attached: some from the brachialis, tending to draw the joint capsule proximally, and some from the supinator, tending to stretch it distally. A pronounced stretching of the joint capsule is necessarily the result of simultaneous activity of the flexors and supinators; constant and frequent repetition of this mechanism may give rise to a chronic inflammation of the joint capsule in this region. As a result of pinching of the inflamed capsule in flexion and extension, pain is produced in the humeroradial articulation, which pain is referred to the epicondyle. Single or repeated sprains of the humeroradial joint are responsible for the condition known as epicondylitis, in the view of Dubs,[11] and also Kaufmann.[13] Fischer[14] and Yersin[15] think that it is due to a neuralgia or neuritis of the fine, extensively ramifying subcutaneous nerve fibers. Remak and Bernhard[3] also classify the affection as an occupation neuralgia, which is not entirely clear, however, since they both ascribe its origin to a periostitis. Franke[8] believes that the symptoms are due to a periostitis of infectious origin, especially as a sequel of influenza. Osgood[10] ascribes the origin of the condition to inflammation of a bursa situated in this region, Schmitt[16] to inflammation and calcification of this

bursa. Coues[9] and Tavernier[17] suggest that it may arise as a result of tearing loose of certain muscular fibers.

Momburg,[18] Blecher,[19] and Bergmann[1] attribute the origin of the symptoms to a localized periostitis. Bergmann[1] states that about half of his cases, especially the older ones, show a thickening of the periosteum which is demonstrable by the roentgen ray. This thickening may vary through all degrees from the slightest to the most pronounced. Reasoning by analogy from the fact that in the early stages of acute severe bone diseases, such as osteomyelitis, the roentgenogram is frequently negative, he believes that the existence of a periostitis in incipient cases may justifiably be assumed, especially if there are other facts tending to confirm this assumption. To further support this, he has operated on several cases, and removed a small fragment of the condyle. Upon histologic examination, a periostitis was found to be present, with no changes in the bone. In his opinion, this periostitis is produced as follows:[1]

". . . If it is remembered that at the external epicondyle and in its immediate neighborhood a large number of muscles have their origins, such as the brachioradialis, the supinator brevis, the extensor carpi radialis longus and brevis, the extensor digitorum communis, and the anconeus, it may readily be seen that a frequently repeated activity of these muscle groups may well be considered as a cause of a periostitis in the region of their origins. The ligamentary structures of the elbow joint, especially of the radioulnar joint, ending in the region of the epicondyle, doubtless play a rôle of equal importance in this connection as an etiologic factor. The conception that through the constant pull of these structures, muscles and ligaments, on the epicondyle, a localized periostitis can arise, is confirmed by the roentgenologic evidence. It must be unconditionally admitted that this etiology can be invoked for the majority of cases of epicondylitis. There is no valid reason for ascribing the chief rôle to the muscles alone or to the ligaments alone, as is done in many quarters."[20]

If this view be accepted it necessarily follows that the majority of cases of epicondylitis should be looked upon as traumatic. This trauma may be a single one in rare instances, or more commonly, frequently repeated minor ones, as a result of occupational or sport activities. To establish this a careful history and study of the case is of the greatest value. On the other hand, there are undoubtedly a small number of cases in which trauma can be definitely excluded; for instance, cases are on record in which the condition developed in the left arm of a person who was decidedly right-handed; sometimes also, the disease passes from one arm to the other. Under such circumstances, however, trauma may enter into consideration

as a result of the increased use of the primarily unaffected arm. Finally, pains similar to those of epicondylitis may appear in the region of other prominent bony points, such as the processus styloideus radii. All such cases in which trauma may be excluded are designated as idiopathic by von Goeldel,[12] and in Bergmann's[1] view may be ascribed to a neuralgic or infectious origin.

From my study of the available literature, from my rather limited clinical experience, and from a first-hand knowledge of the symptoms and course, gained as a result of a personal experience, I am convinced that the great majority of cases are traumatic in origin, and have as their pathologic basis a localized periostitis. However, in support of the latter part of this statement, I have no experimental, histologic, or roentgenologic evidence of my own, but the majority of facts adduced by competent observers seem to favor this view. I have operated on but three cases out of my series of fourteen; in none of them was I able to find any trace of the bursa described by Osgood[10]; in fact, I found nothing at all which I could identify as definitely pathologic. By this I do not mean to say that such a bursa is never present, nor that it is not sometimes the cause of the symptoms, but I do not believe that it can be assumed to be present in the majority of cases. As Osgood admits, and as I have myself verified, it is not described in any of the standard textbooks of anatomy; the one mentioned by Toldt is not so situated as to be able to give rise to the symptoms of epicondylitis. Bergmann,[1] likewise, in an extensive series of cases, many of which were operated upon, has never been able to identify any bursal structure in this neighborhood.

On the other hand, whether a bursa is present or not,—in fact, whether any pathologic change is discoverable or not,—the cases operated upon practically always become symptom free. Does not this fact alone furnish strong presumptive evidence for the presence of a low-grade localized periostitis? To my mind it does, for I believe that recovery in these cases is due to the fact that the healing reaction in the superficial tissues induces sufficient reaction in the periosteum to cause a clearing up of the existent inflammatory process.

The character of the pain in epicondylitis also argues in favor of a periostitis. This pain, when elicited by palpation over the epicondyle, has a peculiar *sore* quality, if I may so express it, and seems to be in, or intimately associated with the bone itself; it closely resembles the pain produced by palpating with moderate pressure a traumatic periostitis elsewhere, as for example, a contusion of the shin or cranium. The pain differs from that of the ordinary traumatic periostitis, however, in that it

is referred down the arm in severe cases, and not confined to the place of origin.

A discussion of the diagnosis need not detain us. As a rule, this is not difficult, being based on the comparatively simple and characteristic symptomatology, with a complete lack of objective findings in most cases. Although frequently negative, the roentgenogram should always be used, if only to rule out other conditions.

The prognosis is good, all cases tending ultimately to recover, although this may take a long time. Untreated cases may be prolonged for months, and sometimes years, chronicity being a feature of the condition. It is always unpleasant and gives rise to great inconvenience, if not to actual disability; it is, however, essentially harmless.

From the standpoint of treatment the means which have been employed are many and various, which is evidence that no one method has accomplished all that could be wished. Local applications, the administration of iodides, salicylates, and quinine internally, hot fomentations, baking, the injection of novocain and other solutions locally, massage, have all been used, with frequently transitory improvement. The iodides and salicylates may have a definite value in those cases in which an infectious or rheumatic origin is probable. In regard to massage, Bergmann[1] warns against it, stating that it frequently leads to an exacerbation of the disease, a fact which is also noted by other writers on the subject.

Undoubtedly the treatment of most value is rest. This rest very often need not be absolute. The occupation and activities of the patient should be carefully analyzed, and those movements prohibited which apparently have given rise to the epicondylitis; if improvement does not occur in mild cases, and always in severe cases, absolute rest of the arm is indicated.

Among the newer remedies which have been suggested is diathermy, and theoretically it would seem to have much to recommend it. A few cases have been reported in which it has been used with apparently marked benefit. I have employed it in but two cases, as an adjunct to complete rest. Both patients were enthusiastic about it, and the duration of treatment was apparently shortened somewhat. I shall use it in the future when occasion arises.

My experience with the surgical treatment has been limited to the three cases mentioned above. The operations were performed on some of my earlier cases, and were really explorations in an attempt to find an explanation for the pain. From this standpoint they were failures, as nothing was found which was grossly pathologic, and no tissues were

removed for miscroscopic examination. On the other hand, from the standpoint of the patient, they were brilliantly successful, as the pain promptly disappeared and did not return. This has likewise been the experience of others. Nevertheless, in the light of what is known about the condition, and in the absence of definite indications, I certainly do not advocate surgical treatment as a routine procedure, and I do not think it justifiable. However, if there are present definite objective signs, either upon physical examination or as a result of X-ray examination, and particularly if there are good reasons to suspect the presence of an inflamed or calcareous bursa, then surgical treatment should enter strongly into consideration, and may even be the method of choice. In proper cases results are undoubtedly much more prompt after operation than after the rest treatment, which may take anywhere from six weeks to three months to effect a cure.

SUMMARY AND CONCLUSIONS

1. So-called "epicondylitis," a condition characterized by pain originating in and about the lateral humeral condyle, radiating down the forearm and hand, and giving rise to disability of greater or less extent, constitutes a definite clinical entity, which it is important to recognize.

2. It occurs almost exclusively in adults between the ages of thirty and fifty, in women more frequently than men, and seems to follow certain occupational or sport activities, particularly those in which the combined movements of supination and flexion of the forearm are employed.

3. The characteristic feature of the condition is pain, as described above, associated usually with a complete lack of objective findings.

4. No definite pathology is known which will apply to all cases. It is probable that the majority of cases are due to a localized periostitis in the region of the external epicondyle, the result of opposing muscle action frequently repeated. A smaller number of cases are undoubtedly due to inflammation or calcification in a bursa which is sometimes found in this region.

5. The ultimate prognosis is good, as all cases eventually recover, but the course of the disease is characterized by extreme chronicity.

6. The great majority of cases in which there is a complete absence of objective findings, are best treated by prolonged rest; diathermy may be of value; a small number, especially those in which the presence of an inflamed bursa is suspected or proved, should be treated surgically.

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". . . Wenn man berücksichtigt, dass am Epicondylus externus und in seiner nächsten Umgebung eine ganze Reihe Muskeln ihren Ursprung nehmen, so der Brachioradialis, der Supinator brevis, der Extensor carpi radialis longus et brevis, der Extensor digitorum communis, der Anconaeus, so kommt eine häufig wiederholte Tätigkeit dieser Muskelgruppen für die Entstehung einer Periostitis an deren Ursprung

wohl in Frage. Eine nicht geringere Rolle als ätiologischer Faktor spielt in diesem Zusammenhang zweifellos auch der in der Epikondylengegend endigende Bandapparat des Ellbogengelenks, vornehmlich des Radioulnargelenks. Die Vorstellung, dass durch den dauernden Zug dieser Gebilde, nämlich der Muskeln und Bänder am Epicondylus, eine lokale Periostitis entstehen kann, ist durch den roentgenologischen Nachweis derselben sichergestellt. Es muss unbedingt daran festgehalten werden, dass diese Ätiologie für die Mehrzahl der Epikondylitisfälle heranzuziehen ist. Entweder nur der Musculatur oder nur dem Bandapparat die Hauptrolle zuzuschreiben, wie es von mancher Seite geschieht, dafür liegen keine greifbaren Anhaltspunkte vor."

AN ATTEMPT TO FUSE THE HIP JOINT FOR TUBERCULOSIS

A Report of the End Result of Ten Cases

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The purpose in presenting this report is not alone to call attention to the difficulties in obtaining a solid bony fusion in the presence of a destructive infection and reduced vitality of the head and neck of the femur and the acetabulum, but possibly to stimulate a deeper study of the methods for treating tuberculosis of the hip joint. It is the observation in this clinic at the present time that this condition is the most distressing, difficult, and unsatisfactory problem we have to deal with. Complications are numerous; recurrence is frequent, sometimes even after long periods of quiescence. One may never feel safe with a tubercular hip joint except in rare cases where complete arthrodesis has taken place.

In our experience, the various operations suggested to obtain a fusion of the hip joint have been unsatisfactory in the majority of cases, as evidenced by the case reports below. In most instances the head of the femur has been dislocated and denuded of its cartilage, the acetabulum thoroughly denuded of its cartilage, and in some cases large bone flaps turned down from the side of the ilium and wedged in between the head of the femur and acetabulum or neck of the femur and ilium; they have either been absorbed or failed to produce sufficient callus to give bone union.

To be successful any operation for fixing the hip joint in tuberculosis must produce a bony fixation; fibrous union, however firm it may be, is not sufficient, because absolute immobilization is necessary. So much strain is placed upon the hip joint that any fibrous union is certain to stretch sooner or later.

Smith-Petersen of Boston, in a personal communication, reports three successful fusions by dislocating the head and denuding it and the acetabulum of their cartilage and diseased bone, and he has had marked success by this same method in correcting the deformity in several cases that had arthrodesis in a poor functional position. In a more recent letter he reports that in the first three cases the symptoms have recurred and

that the patients have been readmitted to the hospital for a second operation.

In a recent search of the literature we found only three men who report successful fusions. Hass of Leipzig reports "Transplant of the Trochanter, Three Cases," with a bony ankylosis in two, and fibrous in one. Kappis of Vienna, "Tibial Transplant from the Trochanter to Crest of Ilium," gives fourteen cases as being successful. H. W. Spiers reports thirty-four operative cases of hypertrophic arthritis and traumatic hips, twenty-five of which he was able to trace. There was firm union in seventeen, questionable in three, non-union in five. In the same paper he states that abduction was retained in only three of the seventeen firm union cases, which would lead one to assume that in fourteen the union was not bony in character.

The hesitancy of the profession as a whole in reporting results and our own experience leads to the conclusion that up to the present time operation for bony arthrodesis of the hip joint cannot be rated among the successful surgical procedures. After a careful study of the problem we feel sure that an operative technique eliminating motion of the tubercular hip joint would, in selective cases, add very materially to our therapeutic armamentarium. It is essential that the operation shall be applicable to children, where the ossification of the femoral head and acetabulum are incomplete. The disease is more frequent in childhood than in adult life, and destruction is more rapid. Any type of operation dealing directly with the joint surfaces and depending upon maintaining bony contact between head and acetabulum is thus excluded. It would seem that some method of extra-articular fixation offers the best hope of success, especially in children. Natural mobility of the part makes complete immobilization difficult and renders it almost impossible to maintain a sufficient amount of bony surface of head and acetabulum in contact to insure the necessary amount of callus production. The large amount of extravasated blood with the tendency to organize into fibrous tissue may be a factor also, and the fact of having present a destructive disease, lowered resistance, and poor vitality of the femoral head and acetabulum.

Hibbs, in 1922, working independently of any knowledge of Hass's work, perfected a technique for extra-articular fusing of the hip joint by transposing the trochanter with its periosteum and muscle attachment undisturbed, so as to make contact above with the ilium and below with the femur, the limb in flexion and abduction. Six cases have been operated upon, but it is too early to make a report, although they appear most promising.

In reviewing the literature for this paper we found that Dr. Hass of Leipzig, January 13, 1923, reported two successful cases and one fibrous, as above, done under similar technique. He cuts the great trochanter free, denuding the upper edge, and fitting this into a groove in the ilium with the leg in abduction, he sutures the trochanter in this position.

CASE REPORTS

CASE I. (17588.) D. V. Diagnosis: Tubercular Hip Joint. Duration of disease at time of operation: eleven years. Patient had been treated with plaster spicas before admission to this hospital. Physical examination showed a dislocation following an old tubercular process; femoral head in posterior superior position; some spasm on manipulation, and marked atrophy. Operation, March 21, 1909. Eight inch incision carried down to capsule of the joint. An encapsulated mass the size of a walnut was found embedded in the muscle just below the acetabulum; a sinus connected this mass with the joint cavity. Capsule opened. The upper rim of the acetabulum was removed as well as a portion of the upper aspect of the femoral head; head reduced, bringing the two cut surfaces in contact. Plaster was applied with limb in a position of 30 degrees abduction, 15 degrees flexion. Plaster removed September 10, 1909. Patient fitted with hip splint. Note on discharge from ward: Open Albee operation for arthrodesis not successful. Last note, October 13, 1916: No adduction.

CASE II. (64573.) H. F. Diagnosis: Tubercular Hip Joint. Duration of disease at time of operation: nineteen years. Age at operation: 23 years. Had been treated with plaster spicas and braces; had not worn apparatus for four years preceding operation but had frequent periods of pain lasting weeks at a time. Pre-operative roentgenograms showed no evidence of active disease. Examination on admission revealed 15 degrees of motion, 15 degrees flexion, and 15 degrees adduction deformity. Marked pain and spasm on motion. Operation, April 10, 1911. An eight inch incision parallel to femur, carried down from anterior superior spine; muscle separated exposing joint; head dislocated forward, cartilage removed; the surface of the articulating bones was roughened to cancellous bone with a curette. Plaster applied, 15 degrees abduction. Discharged June 10, when there was apparently firm bone union, with head of femur in acetabulum. Plaster removed May 29, 1923. Left hip showed no flexion deformity, 10 degrees abduction deformity; rotation neutral; 15 degrees flexion and extension. Roentgenogram at this date shows short neck and flat head with irregular surface; productive reaction present.

CASE III. (25370.) Diagnosis: Tubercular Hip Joint. Duration of disease: eight years. Age at operation: 32 years. Has had no previous treatment. Pre-operative roentgenograms show remaining cartilage thin, acetabulum markedly deepened by disease, superior part of head flattened. Examination on admission to ward: Flexion beyond 145 degrees very painful; rotation, adduction, and abduction markedly resisted. Operation October 1, 1918. Through a ten inch incision, parallel to femur, carried down from anterior superior spine, muscle separated and retracted; capsule exposed and opened; femoral head dislocated forward; acetabulum and femoral head curetted and chiseled; wound closed in layers. Plaster applied with limb in flexed abduction, external rotation. Plaster removed July 1, 1919. Note: Excellent result. Roentgenogram December 29, 1920, showed similar condition as pre-operative. Joint

space still thinner; wide shelf of bone overhanging what remained of head. Bone growth distributed unevenly from this shelf to the neck. No evidence of fusion.

Case IV. (36780.) Diagnosis: Tubercular Hip Joint. Duration of disease: seven years. Age at operation: 44 years. Patient had not been treated for several months prior to entering the hospital. Examination on admission: Partially dislocated hip with a discharging sinus; in external rotation; 10 degrees adduction deformity, 30 degrees flexion deformity. Very tender to pressure. Painful on any attempt at motion. Pre-operative roentgenograms showed active disease involving head, neck, trochanter, and acetabulum, with moderate destruction. Cartilage seemed entirely gone. Operation, April 8, 1920. Through ten inch anterior incision parallel with neck of femur, muscle separated and retracted, capsule exposed and opened. Much caseous material with a necrotic section of capsule removed; about one-third of the neck of femur destroyed; loose fragments, which were curetted and removed. A part of acetabulum and head exposed and curetted; section of bone chiseled up from the neck and wedged between the head and acetabulum. Wound closed in layers. Plaster applied with limb in 15 degrees abduction, 15 degrees flexion. Old sinus tract which led from outer side of thigh was composed entirely of fibrous tissue. Post-operative radiographic condition similar to pre-operative, with some bony growth superiorly at joint line. No evidence of fusion. This patient had subsequently an operation for drainage. He never improved; developed pulmonary tuberculosis; had an amputation of affected leg at hip joint in the Presbyterian Hospital; died December 19, 1922, of amyloidosis and tuberculosis.

Case V. (18488.) Diagnosis: Tubercular Hip Joint. Duration of disease: twenty years. Age at the time of operation: 26 years. Under treatment at the New York Orthopaedic Hospital, 20 years. At time of operation very little motion in hip. Pre-operative roentgenogram showed active disease which had widely involved the acetabulum and destroyed all the head and part of the neck; 15 degrees adduction deformity. Operation, May 18, 1920. Smith-Petersen incision seven inches, parallel with femur from just back of anterior superior spine, five inches back along crest of ilium; gluteus medius and tensor fascia femoris released subperiosteally far enough back to expose the superior and anterior portion of the acetabulum. A shelf of atrophied bone was found antero-superiorly along the rim of the acetabulum; fibrous tissue with caseous material intervened between the shelf and what remained of the neck of the femur. The shelf was of good bone, as was also the cortex of the exposed part of the neck. A little of the latter was chiseled away for better exposure and to allow abduction and flexion. A piece of the cortex one-quarter inch wide and one inch long was turned up and wedged between the shelf; by abducting, the hip was brought in contact with the shelf. Another bone pedicle was stripped from side of ilium above shelf and turned down to still further fill the space between the two bones. Wound closed. Plaster applied in position 15 degrees flexion, 15 degrees abduction. Plaster removed November 25, 1921. Slight motion in hip. Post-operative roentgenograms showed disease more active than in pre-operative pictures. In spite of this there was some bone growth superiorly about the neck and acetabulum. No evidence of fusion. February 10, 1922, patient had operation for reconstruction of internal ligament of knee joint on affected side. February 28, 1922, a second attempt was made to fuse the hip joint. Smith-Petersen incision through scar of previous operation; sub-periosteal release of muscles, exposing acetabulum and joint margin. This had rather a moth-

eaten appearance; several areas of caseation were present; 25 degrees motion, flexion, and extension; abduction limited by impingement of remains of femoral neck on upper rim of acetabulum. Neck of femur exposed; tip of great trochanter bared by subperiosteal dissection; trochanter detached from femur. The tendons of the adductor muscles were then tenotomized at their origin; great trochanter cut free at its base and carried upward so as to impinge on the ilium just above the acetabulum; large bone flap turned up from side of ilium and put in contact with end of base of trochanter. All bone surfaces in contact were freshened. Wound closed. Double spica applied; limb in 15 degrees abduction and 20 degrees of flexion. Post-operative roentgenogram, November, 1923, showed condition similar to that of 1919; disease less active; bony outline cleaner cut; still no evidence of fusion. Disease had extended through pelvis; some calcification had taken place in this region. Last note, November 16, 1923: Plaster removed; motion in hip. Flexion 30 degrees, abduction 10 degrees, rotation 2–3 degrees. No pain, no spasm; hip seems stable.

Case VI. (41732.) Diagnosis: Tubercular Hip Joint. Duration of disease three years. Age at the time of operation: 12 years. Post-operative roentgenogram showed marked atrophy of femoral neck, trochanter very high. Examination on admission showed 45 degrees flexion, 15 degrees adduction, internal rotation 10 degrees. Operation November 23, 1920: Smith-Petersen incision; capsule exposed and opened; head and neck of femur found destroyed; femur dislocated outward. The acetabulum was filled with fibrous tissue, which was curetted to bare bone; end of trochanter cut off transversely. The cut end of the femur was then bevelled downward and outward so that it fitted snugly under the roof of the acetabulum; severed portion of trochanter then brought up in apposition with adjacent portion of the femur and roof of the acetabulum, hoping that it might unite. Wound closed. Plaster applied, 15 degrees abduction, 20 degrees flexion. Post-operative roentgenogram January 19, 1921: bony outline cleaner cut, indicating quiescence; adduction 10 degrees; head and neck of femur gone. End of bone seemed well socketed under roof of acetabulum; trochanter so close it seemed to make contact. Roentgenogram June, 1921: same, except bony outline clearer. June, 1922: upward displacement two inches; hardly any neck visible; 15 degrees adduction deformity, partially dislocated. Last note: Small amount of motion; flexion deformity 40 degrees; very slight adduction. Result, quiescent; fusion has not taken place.

Case VII. (43159.) Diagnosis: Tubercular Hip Joint. Duration of disease: twenty-four years. Age at time of operation: 27 years. Previously treated at another hospital. Pre-operative roentgenogram showed joint space obliterated; head flattened; upper portion of acetabulum destroyed; apparently active disease,—possible Legg-Calvé disease. Examination on admission: Three to four degrees flexion and extension; no abduction, slight adduction; trochanter slightly above Nélaton's line. Operation March 1, 1921: Through Smith-Petersen incision, subperiosteal dissection; capsule exposed and opened; a few loose cartilaginous bodies removed; head and neck found anteverted 90 degrees in relation to transverse axis through condyles of femur; head enlarged, cauliflower-shaped lipping of edges; cartilage pitted and roughened throughout; false acetabulum and shelf extending outward from above, preventing displacement of head; only small part of head engaged in socket; femoral head dislocated; cartilage completely removed from head of femur down to cancellous bone. Acetabulum curetted free of cartilage; limb brought into 15 degrees abduction and flexion, giving fair bone

contact; bone flaps raised from wing of ilium inserted into acetabulum where bone apposition was not perfect. Wound closed. Plaster applied, limb 15 degrees flexion, abduction, and slight internal rotation. Post-operative roentgenograms September, 1921, showed no evidence of fusion. Plaster removed February 27, 1922: Last note, June 2, 1922: Few degrees of motion; fusion has not taken place. Plaster removed February 27, 1922.

Case VIII. (52848.) Diagnosis: Tubercular Hip Joint. Duration of disease: six years. Age at operation: 8 years. Pre-operative roentgenogram showed marked destruction of the acetabulum and head with involvement of neck; apparently active disease. Examination on admission: Flexion deformity 70 degrees, with 5 to 10 degrees further flexion possible. No abduction, adduction, or rotation. Operation, May 11, 1922: Through Smith-Petersen incision capsule exposed and found thickened and fibrous; opened by stripping up its origin from the roof and anterior part of the acetabulum; little cartilage remained on head; neck of femur badly diseased; extensive fibrous tissue surrounding head and filling in acetabulum. Some clean cartilage was found on both head and acetabulum. Owing to the extensive involvement of the femoral neck, it was decided not to try bridging from ilium to this portion or to the trochanter; instead, the fibrous and cartilaginous tissue was curetted from acetabulum and head, dislocating the latter forward to make this completely possible. Good bare bone contact was obtained by this process. Large bone flaps from side of ilium turned down from above into acetabulum and practically bridging straight across. Limb put up in 25 degrees abduction, 50 degrees flexion. Patient discharged to Country Branch, September 1, 1922. Plaster removed March, 1923. Last note: August 8, 1923: Fusion solid, in flexion 25 degrees, abduction 15 degrees; one inch shortening; walks well with slight limp.

Case IX. (54297.) Diagnosis: Tubercular Hip Joint. Duration of disease: one year. Age at time of operation: 21 years. Previous treatment at Porto Rico. Pre-operative roentgenograms showed slight lipping and thinning of joint space. Examination on admission: Motion in all directions markedly limited by muscle spasm. Flexion deformity, 10 degrees. Operation August 8, 1922. Through Smith-Petersen incision capsule exposed and split longitudinally; cut transversely anteriorly and posteriorly at margin of acetabulum. With considerable difficulty the head of the femur was dislocated anteriorly; cartilage found to be destroyed about the ligamentum teres; bone eroded. Cartilage removed from head and acetabulum; deepest portion of acetabulum also found to be diseased. A thin slab of bone two inches long and one and one-half inches wide was turned down from the side of the ilium, fractured over into the acetabulum, and head of femur forced in upon it; a second slab of bone 1 x 2½ inches removed from side of ilium and laid above the denuded head of the femur against the margin of the acetabulum. Capsule closed, wound closed. Plaster applied, limb 20 degrees flexion, 15 degrees abduction, slight external rotation. Plaster removed November 21, 1922. No post-operative roentgenograms. Last note, December 12, 1922: Patient still complains of pain in hip; hip firm and in good position. Patient returned to Porto Rico.

Case X. (59853.) Diagnosis: Tubercular Hip Joint. Duration of disease: four years. Age at time of operation: 26 years. Pre-operative roentgenograms showed joint space almost obliterated; marked cavitation in superior part of acetabulum and head. Flexion deformity 20 degrees, with 10 degrees adduction; motion limited in

every direction by sharp pain and muscle spasm. Operation December 8, 1922: Through Smith-Petersen incision capsule exposed and opened. On incision of capsule, three ounces of greenish-yellow pus gushed out; floating in the pus were fragments of detached cartilage. Capsule was separated from ilium above and anteriorly by adduction and internal rotation. The head was dislocated and found almost entirely denuded of cartilage; remaining cartilage was removed down to cancellous bone. About the point of insertion of the ligamentum teres, which was destroyed, bone was white and eburnated; cartilage of acetabulum almost entirely destroyed; cavity half filled with granulations and fibrous material; this was thoroughly curetted down to bone; hip reduced and fragments of bone turned down from side of ilium to bridge across and come in contact with neck of femur. Plaster applied, 30 degrees flexion, 20 degrees abduction, 15 degrees external rotation. Roentgenogram November 30, 1923: Active disease; five degrees abduction deformity; evidence of bone growth between neck and wall of ilium, but much decalcification.

CONCLUSIONS

1. Results obtained in the treatment of tubercular hip joint at the present time are the most unsatisfactory of all the problems with which the orthopaedic surgeon has to deal.

2. This is true because fixation of the joint is essential to cure. It cannot be accomplished by apparatus, and no operation has been devised as yet that will assure bony arthrodesis.

3. The operations reported in this series were, with one or two exceptions, complete failures.

4. The paucity of the literature on the subject and the unsatisfactory results of the cases reported are evidence of the lack of any successful operations for obtaining complete arthrodesis of the hip.

5. In order to be successful, the operation must assure complete bony arthrodesis and must be applicable to children.

Causes of Failure. Poor vitality and low resistance of the femoral head and acetabulum in the presence of a destructive disease. The difficulty in maintaining immobility, and in children incomplete ossification. Small amount of bone contact with its tendency to organize into fibrous tissue, large amount of blood actually surrounding the bone fragments, and perhaps poor blood supply in the bone itself.

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THE ACCESSORY SCAPHOID BONE*

BY EMIL S. GEIST, M.D., MINNEAPOLIS, MINN.

The accessory scaphoid bone (os tibiale externum) has been described by anatomists for many years and its frequency of occurrence has been definitely established. Nevertheless, many surgeons are not yet acquainted with this normal structure and mistake the accessory scaphoid for a piece of bone broken off from the scaphoid. The accessory scaphoid bone occurs in from 10 to 14 per cent of normal feet.

In 1914 I published a paper entitled "Supernumerary Bones of the Foot—A Roentgen Study of the Feet of One Hundred Normal Individuals."[2] The previous studies of Pfitzner and Dwight on the same subject were open to the one objection that their material was all from the "dead house," and it was not known whether during their life-time the subjects presenting these accessory bones had ever sustained injuries of the feet or had complained of foot trouble. I therefore availed myself of an addition of which Pfitzner could not avail himself—the Roentgen ray—and the study above mentioned presented the results of radiograms of the feet of one hundred persons who had never had a foot injury or foot complaint. My findings regarding the accessory scaphoid (os tibiale externum) were as follows:

"This has formerly been taken to be an accessory bone in the tendon of the tibialis posticus muscle. According to Dwight,[1] however, this is not the case, but is a true part of the skeleton. It is situated behind and slightly below the tubercle of the scaphoid. It may be large or small. It is often unilateral and is easily shown by the X-ray and is frequently misinterpreted as being a fragment broken off from the tubercle of the scaphoid bone."

It is apparent, then, that we are dealing with a structure which is not a sesamoid bone and which, in a large number of cases, articulates with the scaphoid by means of a true joint more or less completely developed. On two occasions we found, on operative removal of this accessory scaphoid, that there existed articular cartilage as well as synovial membrane in the joint between the two bones. This observation was verified by Dr. Robert-

* Read before the Minnesota Academy of Medicine on November 12, 1924.

son, who was at that time connected with the Department of Pathology at the University of Minnesota.

In 1923 I published a paper in the *Surgical Clinics of North America*, Volume 3, No. 5, entitled "Foot Disability: An Analysis of 781 Consecutive Cases."[3] At that time I attempted to show that not all foot disorders for which the patient consults the orthopaedic surgeon are so-called cases of "flat foot." In fact, in about two-thirds of the cases of foot disability reported in that series, there existed some other definitely ascertainable pathologic lesion of a different nature than weak foot. In that communication I published under the subtitle "Disturbance of the Accessory Scaphoid," the following:

"Twelve cases. As far as the writer knows, this condition has not been previously described. Ages range from twelve to forty-three, average age being eighteen. Occurred eight times in females and four times in males. Symptoms were unilateral in eight cases and bilateral in four cases. The unilateral: right foot, 5; left foot, 3. Roentgenogram showed unilateral accessory scaphoids in 5 and bilaterals in 7 cases."

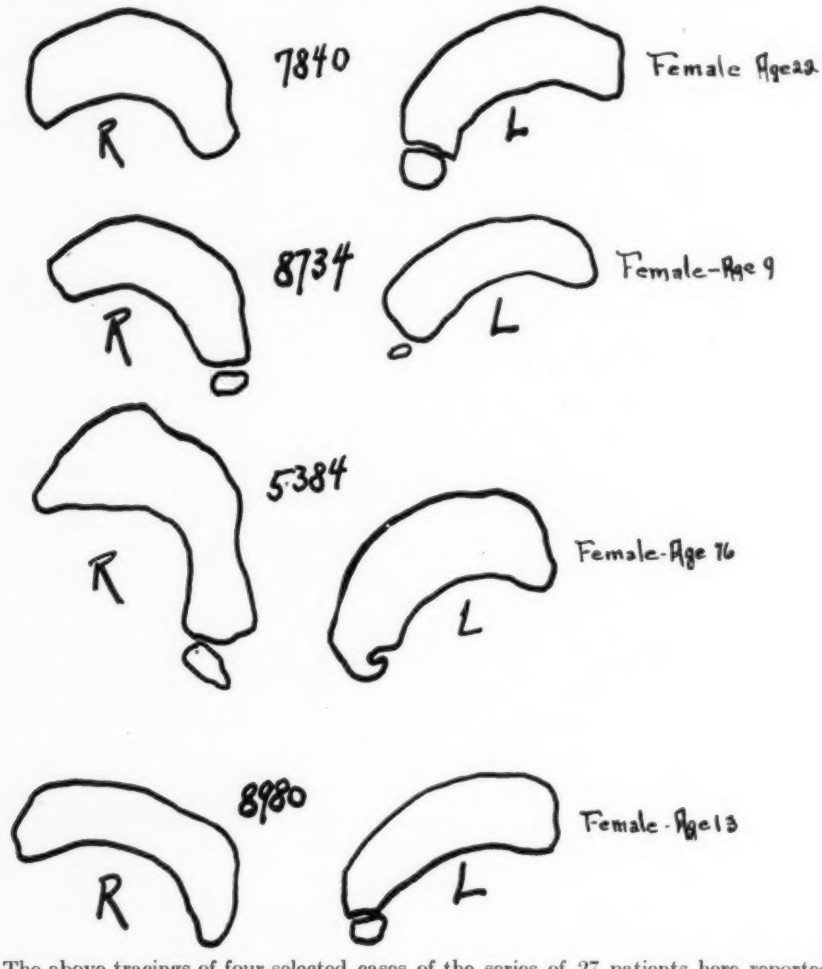
For the past ten years my attention has been drawn to the subject of painful accessory scaphoids, the first operative removal of this bone having been done by me in 1915. Since then I have been on the lookout for similar cases and I wish to report twenty-seven cases of a foot disorder which I term "Disturbance of the Accessory Scaphoid."

Pathology. In the two cases above mentioned in which the specimens were submitted to Professor Robertson, he reported in oral communication that there existed evidence of "chronic inflammation" in the joint between the accessory scaphoid and the scaphoid bone. Beyond this we can only surmise the causation of pain in these cases. There are at least three different explanations why the presence of this accessory bone may cause pain:

(*a*) The articulation between the two bones (being a true joint) may be affected by any of the ordinary joint diseases. In this region one would expect traumatic arthritis following mild injuries, and this, I believe, is the case in the majority of cases.

(*b*) The tendon of the tibialis posticus lies immediately behind and over the tubercle of the scaphoid, certain of its fibers inserting into the scaphoid tubercle. When an accessory bone is present, this tendon may partially surround it—in fact, the accessory scaphoid may be partially inbedded within it. (For this reason, the accessory scaphoid has been called by some, a sesamoid bone.) There may exist irritation of the tendon sheath of the tibialis posticus due to pressure.

(c) According to some of the anatomists (Grey, Piersol) there sometimes exists a bursa between the tendon of the tibialis posticus and the



The above tracings of four selected cases of the series of 27 patients here reported show some of the varieties of shape and size the accessory scaphoid bone may assume. As a rule the roentgenogram shows a well defined articulation between it and the scaphoid bone.

bone immediately in front of it (scaphoid or accessory scaphoid) and it is possible that this bursa may be inflamed and irritated.

It is possible that these three causes enter into the etiology of the tenderness and pain observed in these cases.

(On account of the youth of most of the patients I was for a time of the opinion that we might be dealing here with a disease process similar to the "Legg-Calvé-Perthes Hip" and the "Osgood-Schlatter Knee." I am no longer of this opinion.)

Symptoms. The symptoms of this disorder are simple, and in our work we have arrived at a point where we are able to "spot" these cases before the radiogram is made. The chief subjective symptom is definite pain in the region of the tubercle of the scaphoid bone; otherwise there are no foot complaints. On examination the region of the tubercle of the scaphoid will be found to be extremely tender. In a few cases there was present moderate swelling and in one or two even redness. The disorder is frequently unilateral and occurs much more frequently in females than in males. The condition occurs more frequently in patients under eighteen years of age. Only a few of our cases were accompanied by signs and symptoms of weak foot. In the great majority of cases there was isolated tenderness over the scaphoid tubercle.

Differential Diagnosis. The only disorder to differentiate is ordinary weak foot. This is, as a rule, easy. Flat foot is practically always bilateral, whereas the disorder here described is very frequently unilateral. In weak foot we have other points of tenderness about the foot. There exists more or less rigidity and there exists, of course, also more or less valgus deformity. Most of the cases in this series presented no valgus whatever, and beyond the tender spot complained of over the tubercle of the scaphoid the foot was normal. It may be said in a small number of cases in this series (six or seven) there existed a disturbance of the accessory scaphoid plus the symptoms of ordinary weak foot.

Treatment. The treatment of this disorder should at first always be conservative—that is to say, braces should be tried out. It must be said that in our hands conservative means have not been very successful. Our notes show that in only nine of the twenty-seven cases was there relief on the application of braces (in-soles). In the balance there was no relief, and in fifteen cases operation was recommended. Operation was done in six cases. Operation consisted of removing not only the accessory scaphoid but also the articular cartilage covering the tubercle of the scaphoid, and was in each case followed by relief of symptoms.

The following is a tabulation in brief of the twenty-seven cases that were observed during the past ten years. (During this time we have called this condition a variety of names, to wit: "Disturbance of Accessory Scaphoid," "Irritation of Accessory Scaphoid," "Irritatio Os Tibiale Externum," "G.'s Disease," "Painful Accessory Scaphoid.")

Total number of cases	27
Sex—Males	8
Females	19
Bilateral	15
Unilateral (right 7; left 5)	12
Local tenderness over accessory scaphoid	27
Cases showing other signs of weak foot	7
Eighteen years or under	16
Over eighteen years	11
Braces gave relief, cases	9
Operation advised in cases	15
Cases operated	6

Hohmann,[4] in 1923, reported a similar case in which he removed the accessory scaphoid.

CONCLUSION

I. It appears that we are dealing with a separate disease entity which can be differentiated from "weak foot."

II. The pain and tenderness may be due to:

a. Irritation of the joint between the scaphoid and accessory scaphoid.

b. Irritation of the tendon of tibialis posticus.

c. Inflammation of the bursa between the tibialis posticus tendon and the accessory scaphoid.

III. As to treatment, conservative means should be tried out. In stubborn cases, removal of accessory scaphoid is indicated and relief of tenderness and pain can be expected.

IV. I would suggest for this disorder the name: "Disturbance of Accessory Scaphoid Bone."

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THE ARCHITECTURE AND THE BLOOD SUPPLY OF THE HEAD AND NECK OF THE FEMUR AND THEIR IMPORTANCE IN THE PATHOLOGY OF FRACTURES OF THE NECK

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The question of fracture of the neck of the femur is still an unanswered one in spite of the brilliant work of Whitman and others. The abundant and continued growing literature on this subject does not seem to clear up this field. Controversies as to methods of operative treatment of fractures of the neck are followed in the literature by controversies as to the causes of the exclusiveness of this particular kind of fracture. On the other hand, ever so often we read in the literature calm statements that there is nothing unusual about fractures of the neck; that non-union of fractures of the neck is merely talk, that the only cause of poor results in some hands is bad coaptation of the bone fragments: in short, that the exclusiveness of fractures of the femoral neck is not well grounded. Such a discrepancy of opinion in a question of primary importance is rather suspicious. More so, when we recall that 27% of all fractures of the femur belong to the group of fractures of the neck. We believe this discrepancy to be largely due to the fact that there still are anatomical facts about the femoral neck and head which are not sufficiently appreciated by many clinicians. This is especially true of the old question of the peculiarities of the blood supply of the head and neck of the femur. This is also true as far as the architecture of the femoral neck is concerned. Both the architecture and the blood supply of the neck and head play an important rôle in the pathology of fractures of the neck.

The remarkable adaptations to its functions have long been recognized in the human upper femur. Especially instructive is the work of Roux and of Julius Wolff. The latter, in 1892, formulated the law of bone transformation. It was in opposition to Volkmann's pressure theory, according to which increase in pressure was to depress, decrease to stimulate the

growth of bone. Wolff maintained that pressure or traction forces applied to a bone lead to formation of pressure or traction lines of force according to laws of static and to arrangement of the structure of the bone into lamellar systems following strict mathematical laws. Wolff's belief was that static conditions alone govern the anatomic configuration of a bone, and pathologic conditions can and do lead to structural changes as a result of an adaptation of the bone structure to the changed static conditions. Not going into details of the discussion of this law in the literature, we think it safe to say that at the present time most authors accept Wolff's transformation law with some reservations. It is the opinion of the majority that the change of statics is not the exclusive, but a very important, factor in production of bone transformation. The other very important factor is the muscle traction, which is transmitted to the ligaments and joints. The static conditions and the muscle traction are the components defining the function of the bone. The bones have not merely a functional structure, but also a functional configuration. In other words all features of a bone are a product of its function. From here we can easily see in what close relationship is the pathology of deformities of the femoral neck to its architecture. This led Sudeck to demonstrate the relation of coxa vara to the architecture of the neck. We shall attempt in the following to demonstrate the relationship of pathology of fractures of the neck and the architecture of the upper femur. For this purpose we shall first outline the main points of interest in the structure of the femoral neck. In this study we made use of special dissections of the human femur, of wax reconstructions of fetal femora, of X-ray studies of serial sections of the femur, and of experimental fracturing of femora in a testing machine.

The architecture of the upper femur is much better understood if we will consider the upper third of the femur as a curved lever, a tubular structure, a continuation of the tubular shaft to which projecting masses are attached for insertion and origin of muscles and ligaments. Such a view of it simplifies much the comprehension of the mathematical laws which govern the factors of safety of this portion of the bone. Later we shall see that this consideration of the upper femur is in accord with real anatomic facts. This curved lever—the femoral neck—plays an extraordinary important rôle in the transmission of body weight from the acetabulum to the tibia. Each neck carries 30% of the body weight in standing position and 80% in walking. We believe that this function of the femoral neck has to do with its changes in configuration which follow after birth in a far greater degree than is usually thought.

We can see three main changes in the anatomic configuration of the femur from early fetal life until adult age. The most important of these changes is the antetorsion of the head and neck of the femur. If we pass

FIG. 1

Photograph of the upper femur after both trochanters and the intertrochanteric ridge were rasped away. The lines show the angle of antetorsion of the head and neck in relation to the upper femur just beneath the intertrochanteric ridge.

a plane through the transverse axis of both condyles of the femur and a point of the shaft just below the great trochanter, the head and neck of the femur will appear anterior to this frontal plane. This displacement of the head and the neck to the front could take place as a result of several processes. The upper femur with head and neck have rotated around the

central axis of the femur. Therefore the neck will have rotated about its own central axis and at the same time is brought forward as a result of the torsion of the upper femur around the axis of the shaft. The mentioned displacement of the head and neck can also be a result of an anteversion

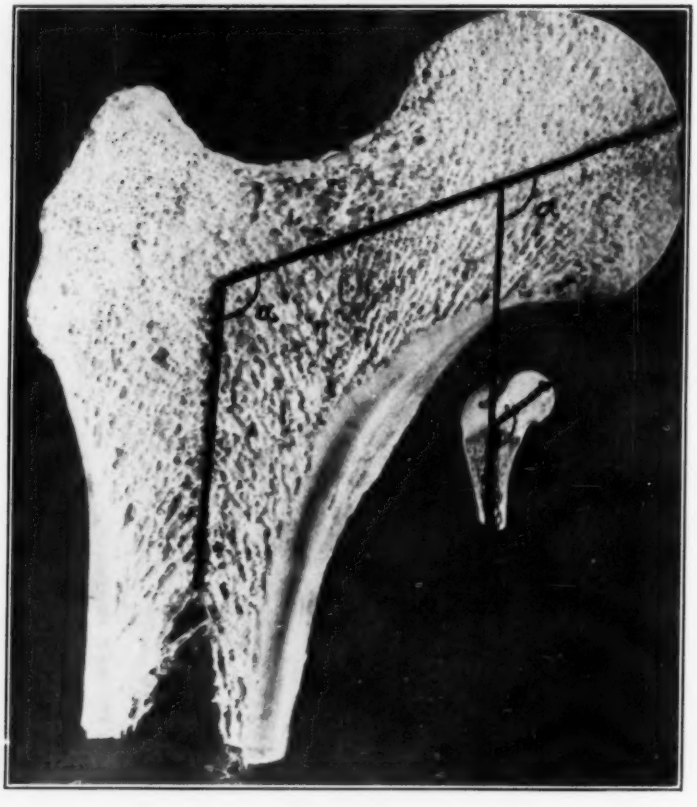

FIG. 2

Photograph of central longitudinal sections of a femur of an adult and of a new-born, comparing the angle of the neck with the shaft. The angle in the adult is markedly smaller than in the new born.

of the femoral neck. As a matter of fact, both these processes take place in the femur, although not in an equal degree, torsion being of far greater extent than version. We believe that there is another factor which has been neglected in the past, which leads to the antetorsion of the head and neck. Most careful measuring of the angle of torsion of the neck

itself in relation to the portion of the shaft just beneath the great trochanter shows it to be about 30° in an adult. This angle is rapidly increasing the more proximally (towards the head) we go in our measuring. We believe this to be due to the following: When the body weight presses upon the head the latter can not be displaced forward because of the strong anterior portion of the joint capsule. Meanwhile, it has a tendency to move posteriorly as a result of the institution of static functions, which places greater weight stress upon the anterior segment of the head. This displacement results in a supplementary antetorsion of the head and proximal portion of the neck and in a retroversion of the head of the femur. The antetorsion leads to placing the flattened neck with its large diameter in vertical direction and is, therefore, very important as a factor increasing the margins of safety of the femoral neck.

The second change in the anatomic configuration of the femoral neck is its flattening. This change takes place after birth. In children up to one year indications of flattening were hardly noticeable. The degree of flattening in a fully developed femur can be expressed by the ratios 4:6 in the upper portion and 3:6 in the lower half of the neck.

The third main change in the configuration of the femoral neck is the bending of the neck. Under the load of the body weight the neck is subject to bending. The angle of the neck with the femoral shaft is about 145° in the newborn. In later life it decreases considerably: in our measurements the average angle in an adult is 115°. There has been much discussion in the literature of this decrease in the size of the angle, many authors doubting it entirely. Our careful repeated measurements proved to us that such a decrease is beyond any doubt. Figure 2 speaks for itself.

Considering the upper femur as a curved lever is in accord with real anatomic facts. If we carefully rasp away the great trochanter, the small trochanter, and the intertrochanteric ridge, we shall see that there is a surface beneath these structures which is a direct continuation of the superior and posterior surfaces of the femoral neck. This surface can be considered the physiologic outer surface of the neck in distinction to the anatomic outer surface containing all the processes apposed upon the physiologic surface for attachment of muscles and ligaments. The most satisfactory way of studying this buried physiologic surface is to dissect the bone in thin slides parallel to the frontal plane. A careful examination of these sections reveals the physiologic surface buried beneath the great trochanter superiorly, the small trochanter inferiorly, and the intertrochanteric ridge posteriorly. It is still more conspicuous in roentgenograms of such sections. The buried plate of compact bone, representing

a continuation of the superior and posterior walls of the tubular shaft of the femur, was discovered by Rodét and called "lame soustrochantinienne." It is better known under the name "calcar femorale" given by Merkel. It is about one cm. wide. The calcar femorale forms only a portion of the

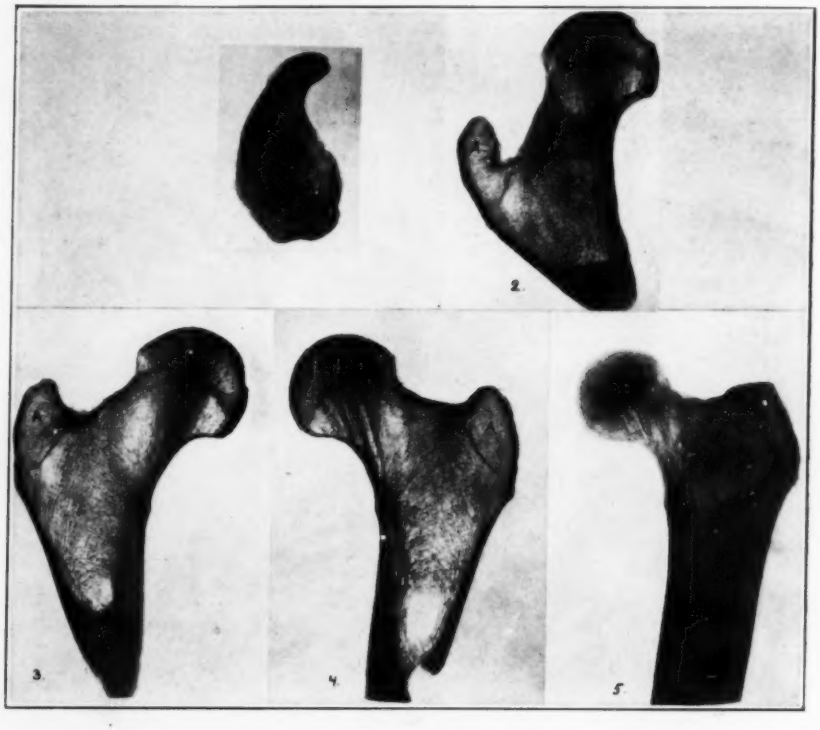

PLATE I

Roentgenograms of serial frontal sections of the upper femur, showing the architecture of the neck, the lamina femoralis interna, and the epiphyseal line of the great trochanter. The lamina femoralis interna and the epiphyseal line of the great trochanter are not identical, but two different structures.

A, Great trochanter; C, Small trochanter.

buried physiologic surface of the neck. The longest and main portion is formed by the strong arching plate spreading beneath the great trochanter. The calcar femorale and the subtrochanteric (great trochanter) arch together form the lamina femoralis interna. It has been suggested that the lamina femoralis interna represents the surface of the diaphysis of the femur, which became covered up at a later date by the developing

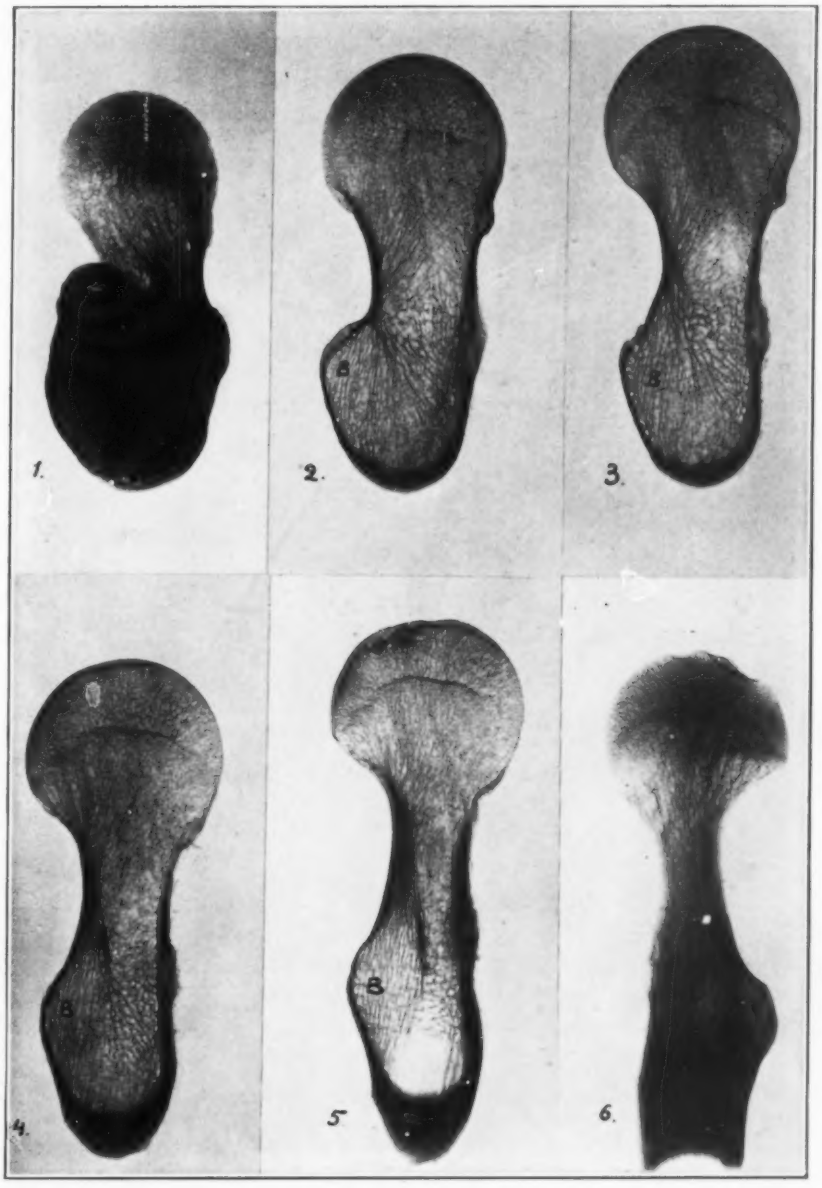

PLATE II

Roentgenograms of serial sagittal sections of the upper femur, showing the lamina femoralis interna separating the trochanters and the intertrochanteric ridge from the tubular main portion of the neck. Section 3 shows Ward's triangle.

A, Great trochanter; B, Intertrochanteric ridge; C, Small trochanter.

apophyses of the great and small trochanters. That this suggestion does not hold we agree with Dixon.[1] Repeated examinations of young specimens showed that the lamina femoralis interna is not in any way to be

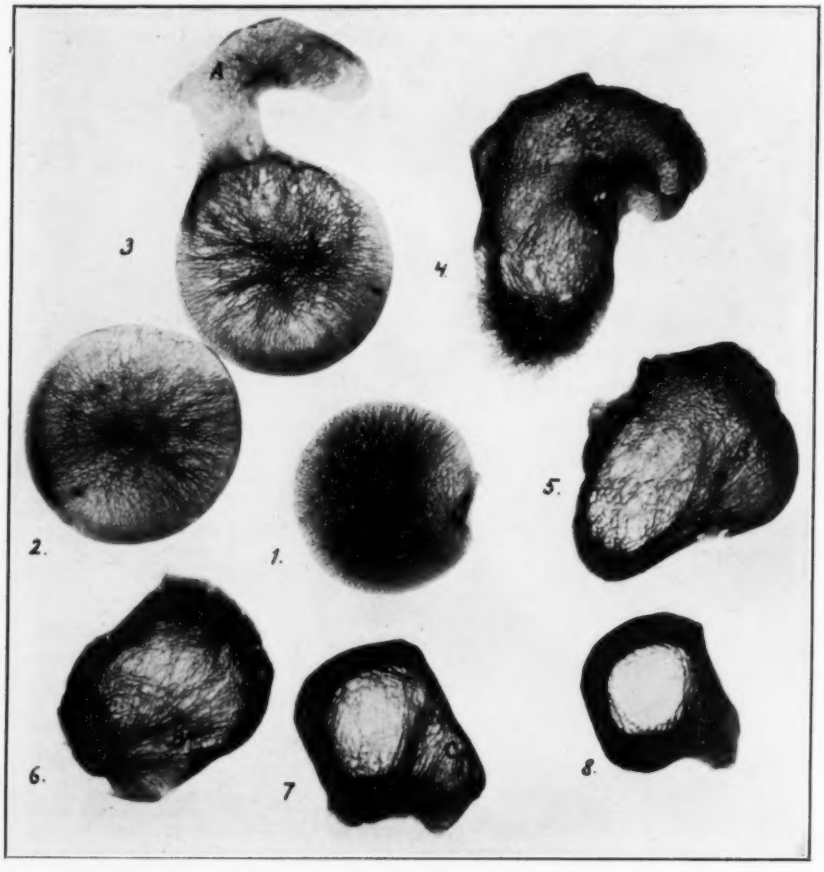

PLATE III

Roentgenograms of serial cross-sections of the head and neck of the femur, showing the architecture of the head and the lamina femoralis interna.

A, Great trochanter; B, Crista Intertrochanterica, joining the great and small trochanters; C, Small trochanter. Between A, B and C and the tubular portion of the neck is the lamina femoralis interna.

identified with the epiphyseal line of the great and small trochanters. In this way we came to the conclusion that the lamina femoralis interna is of physiologic and not merely of morphologic importance. Its purpose is

to widen the margins of safety of the neck, to strengthen the most endangered portion of the neck—the superior and posterior walls—the sites of greatest tension under the load of the body weight.

Another point of importance as far as the increase of the margins of safety of the femoral neck is concerned has not been emphasized strongly enough in the literature. If we examine the articular surface of the femoral head we shall notice that the articular cartilage continues on the superior

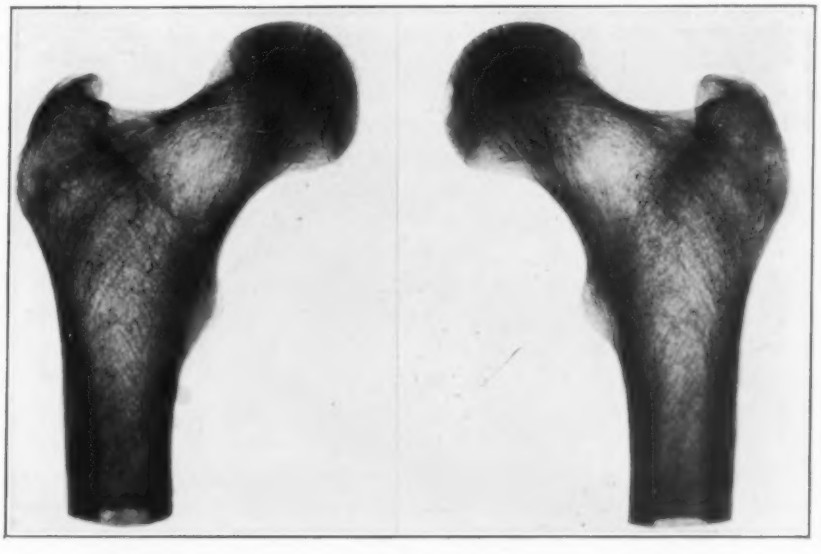

PLATE IV

Antero-posterior and postero-anterior roentgenograms of the upper femur, showing the tension and pressure lamellae and Ward's triangle. Note the intersection of the lamellae in the femoral head.

aspect of the neck for about one and one-half centimeters. The bone beneath the cartilage here is elevated, forming a distinct eminentia. Sudeck[2] was the first to call attention to this eminentia. Later it became known under the name of "eminentia articularis colli femoris," or "empreinte iliacque" in the French literature. It is our belief that this elevation of compact bone serves to increase the margins of safety of the femoral neck by strengthening the upper most endangered pole of the neck. It leads to a displacement of the upper end of the eventual fracture line from the edge of the articular surface of the head distally, i. e., a displacement from a line parallel to the direction of the tension lamellae to a line crossing the

tension lamellae at an angle. In this way this eminentia increases the shearing moment of the tension lamellae at the proximal portion of the femoral neck.

A good and clear roentgenogram of a femur sectioned in different planes shows other interesting points of structure. The neck of the femur seems to consist of bone lamellae which arise from the shaft and extend from it in a rather peculiar way. The bone lamellae which arise from the external side of the femur shaft (external condyle) arch towards and run farther in the neck, continue there and end in the femoral head perpendicular to its surface. These bundles of trabeculae prevent the laceration of the neck; they are the tension lamellae. From the internal condyle other bundles of bone trabeculae arise which run to and into the neck, cross the tension lamellae at a right angle and end in the femoral head perpendicular to its surface. These are the pressure lamellae. They counteract the compression of the neck. In arching towards the femoral head and neck both groups of bone lamellae wind spirally. This winding, we believe, is a result of the antetorsion described above. The pressure lamellae run in the direction of lines of maximum compressive strength. They branch in the posterior, inferior and anterior wall of the neck, while the tension lamellae spread mainly in the superior and to a slight degree also in the anterior wall of the neck. This unequal development of the lamellae we think is conforming to the function of the neck. The task of the pressure lamellae of the neck of the femur is markedly heavier than that of the tension lamellae, the latter being supported in their function by several strong muscles inserting in and about the great trochanter.

The pressure and tension lamellae form what is known under the name of trajectoria. The pressure trajectorium arises from the internal condyle, branches in the neck in the lamina femoralis interna, runs to the superior aspect of the articular surface of the femoral head, continues through the acetabulum and passes to the vertebral body of the first and second sacral vertebra. In this way it forms what H. V. Meyer[3] called the trajectorium of the erect position (der aufrechten Stellung) of the human body. In disregard of the opposition of some authors to this interpretation of Meyer, we believe this to be correct, since our study of the skeleton of quadrupeds showed the presence of this trajectorium of the erect position not merely in the femora and hip joints, but also in the shoulder joints and humeri, which in these animals are supplied with a weight-carrying neck.

The crossing of the tension and pressure lamellae takes place mainly

in the femoral head. The head is composed of a scanty substantia compacta and of numerous spongiosa trabeculae which are arranged like the spokes of a wheel. Mathematically this arrangement is very important since it

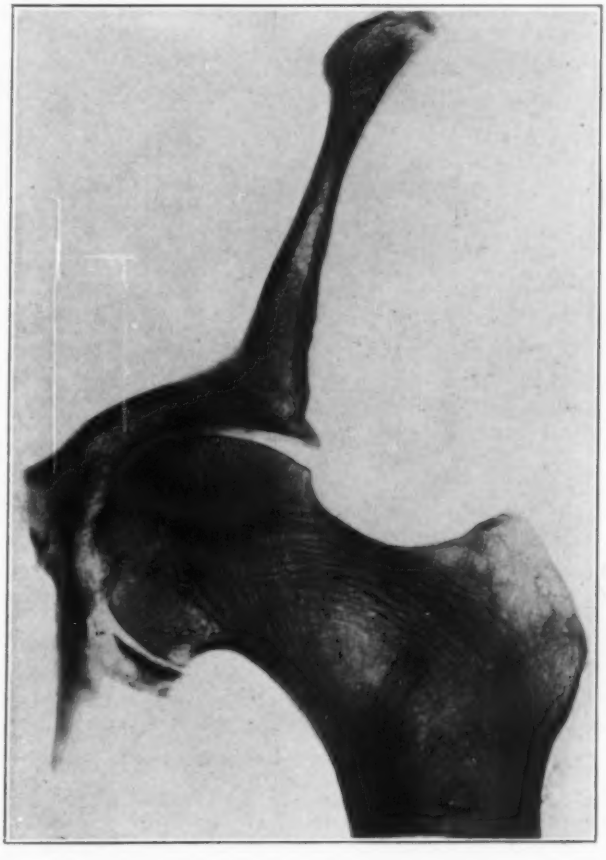

FIG. 3

Roentgenogram of a section through the hip joint with the femur in situ. Note the trajectorium of the erect position as described in text.

prevents a centripetal compression of the head. These trabeculae are interwoven with those which come from the neck, interlacing like the groins of a gothic arch.

Besides the tension and pressure lamellae described above, there are

bundles of bone lamellae which run from the lamina femoralis interna to the great trochanter. These lamellae cross the tension lamellae at right angles.

As is seen from the figures of Plate IV all these three systems of bone lamellae describe, by their main masses, a triangular space which

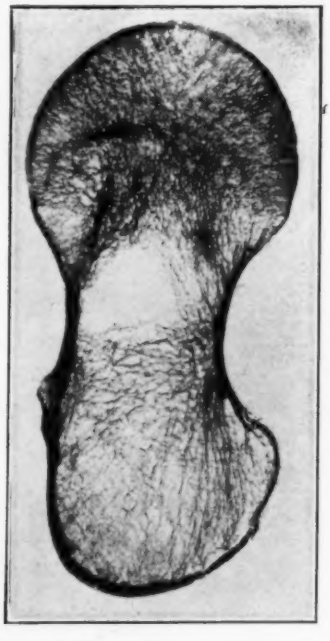

FIG. 4

Roentgenogram of a sagittal section of the femoral neck of a man 60 years old. Note the absence of spongiosa in one portion of the neck,—the trigonum internum femoris (Ward's triangle).

is poor in bone trabeculae. This is Ward's triangle (trigonum internum femoris), mentioned by Ward[4] in 1838. Our study leads us to believe that this triangle is the point where atrophy and rarefication of the upper femur begins in general skeletal atrophy and in old age. While in young, strong, muscular and bony persons this triangle is filled with spongiosa bone, in elderly persons this space is lacking any bone trabeculae, and because of this it diminishes the margins of safety of the femoral neck,

and is therefore a locus minoris resistentiae of the femoral neck. Fractures are produced through this area when the isolated femur is subjected to vertical compression.

It has been figured out mathematically that the weakest point of the femoral neck, if the latter were of a homogeneous tubular structure, is the area marked in figure 5 by the line AB. However, the strong bone lamellae radiating from the great trochanter along the superior surface of the neck towards the head, on one hand, and Ward's triangle on the other, cause the displacement of the linea minoris resistentiae AB to CD, so that fractures as a result of vertical compression would occur closer to CD than AB. To determine whether or not our deliberations were correct we performed a series of experimental fractures of femora in a testing machine.* Isolated femora freshly removed from the body were used and two different series of experiments were conducted. In one we tested the femora by vertical compression: the femur rested on both condyles, the point of pressure was the upper circumference of the articular surface of the femoral head. This is more or less equivalent to a femur subjected to force in a fall on the heels or knees while in erect position. In the other series we tested the femora by lateral (horizontal) compression: the femur rested on the medial aspect of its head and on the internal condyle, the pressure force being applied to the great trochanter. In life it corresponds to a fall or a blow on the hip.

The weight required to produce a fracture of the femur varied with the sex, race, and age of the owner of the bone. It also varied greatly with the direction of the applied force—whether it was subjected to vertical or lateral compression. A femur of an average female of the fifth decade fractured under 980-1100 lbs. in vertical compression, while a femur of an average male of about the same age required 1200-1300 lbs. In ceteris paribus the bones of negroes require more weight than the bones of white persons. In testing femora of persons above the fifth decade we found that the weight required for producing bending of the bone is the same as that required for fracturing the bone. When bones of young persons, especially of well built males, were subjected to vertical compression, we reached a weight when the femur fractured in the upper third somewhere below the intertrochanteric ridge, but the neck remained intact. To exclude from consideration the factor of length of the femur we tried to experiment with femora of about the same length. Both femora of the same persons were tested, and in both cases exactly the same weight was required to

*It is our pleasure to thank Professor Rogers of Lewis Institute, Chicago, for his help and advice in conducting these experiments.

produce bending and also the same weight to produce fracturing of the bone in the same place.

We consider of great interest and physiologic importance the following fact noticed in our testing work: A femur of a normal healthy middle-aged adult required more weight to reach the bending moment than it required

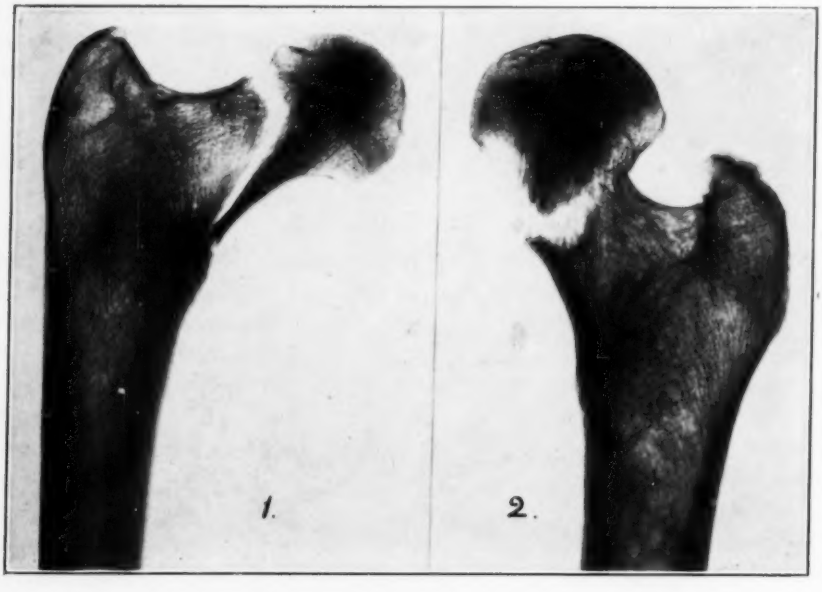

PLATE V

1. Roentgenogram showing the experimental fracture of a femur of an elderly woman produced by vertical compression in a testing machine under the weight of 850 lbs. The antero-posterior plane of the fracture begins above at the outer edge of the eminentia articularis colli femoris and passes through the internal portion of Ward's triangle.

2. Roentgenogram showing an experimental fracture of a femur of a man 32 years old produced by lateral compression in a testing machine under the weight of 450 lbs.

to reach the fracturing moment. In our testing, the bending moment was reached at about 2050 lbs., while the fracturing moment of the same bone was reached at about 1950 lbs. In other words, less weight was necessary to fracture a femur than to bend it. This rather surprising fact is readily explainable mechanically. Bending moment is a product of weight by arm (length). At 2050 lbs. the bone begins to bend. The fracture moment of the *straight* bone is not yet reached. After the bone is

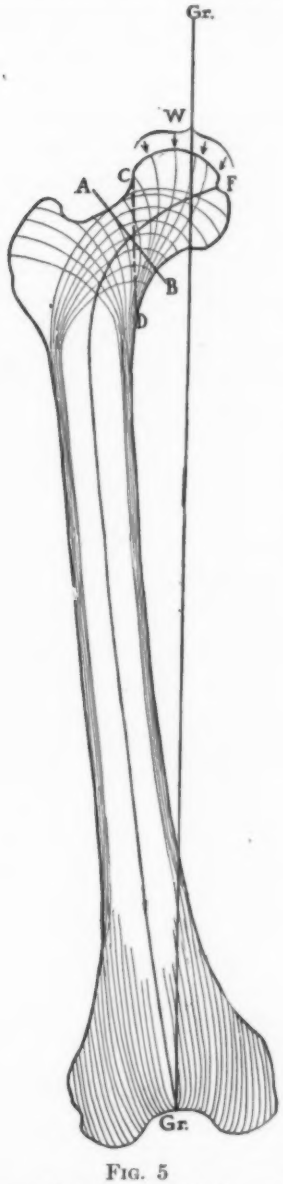

FIG. 5

A scheme of the mechanics of the neck of the femur. The drawing represents a central frontal section of the femur. Line "*Gr-Gr*" is the line of the axial pressure of the body weight, transmitted upon the tibia in the point "*Gr.*" Line "*F-Gr*" is the "neutral line," where neither pressure nor tension forces are transmitted. "*W*" is that portion of the body weight which is carried by one femoral neck. Line "*A-B*" is the line through which fractures of the femur would pass if the neck were a curved lever of a homogeneous structure. This line has been determined mathematically. Line "*C-D*" is the actual line through which fractures of the neck from vertical compression pass in elderly individuals.

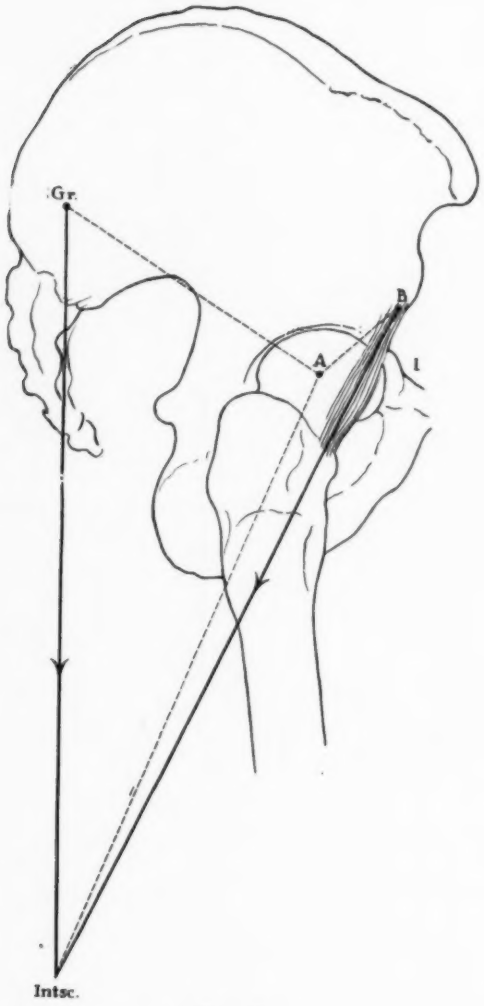

FIG. 6

A scheme of the mechanics of the hip joint. Point "*Gr*" is the center of gravity of the body in vertical position. Line "*Gr-Intsc*" is the plumb line. Point "*A*" is the projection of the axis of the hips. Line "*B-Intsc*" is the continuation of the line of force of traction of the ileo-femoral ligament. Point "*Intsc*" is the point of intersection of the plumb line and the line of traction of the ileofemoral ligament. Line "*A-Intsc*" is the resulting line of lines "*Gr-Intsc*" and "*B-Intsc.*" It represents the direction of the axial pressure.

Note that the line "*A-Gr*" is considerably longer than the line "*A-B.*" We believe this to be the cause of the supplementary antetorsion of the head and neck of which we speak in the text.

bent its bending moment is less than that of the straight bone, and the weight in the testing machine drops automatically. Immediately the bone begins to return to its previous straight position, producing a rapid increase in weight. But since the fracture moment of the bent bone is less than the bending moment of the straight bone the latter fractures before it has time to return to its straight shape.

In testing the femoral neck under lateral compression the weight required for fracturing varied much less with the age, sex, and race. An average of about 375 lbs. was sufficient to fracture a femur in lateral compression. In old or disabled persons the bone usually fractured just above the intertrochanteric ridge, while in strong middle-aged adults it usually ran as shown on roentgenogram 2 of Plate V.

Of great importance in the mechanics of the hip joint are its two strongest ligaments: the ileofemoral and the ischiofemoral. The function of the ileofemoral ligament in balancing the body load upon the head of the femur is illustrated on figure 6. This ligament prevents the retroflexion of the pelvis as a result of the physiologic position of the center of gravity of the body in the sacrum. The ischiofemoral ligament plays an important rôle in the pathology of fractures of the femoral neck. The cause of the eversion of the thigh in unimpacted fractures of the neck has always been problematic. In a special dissection of the hip joint we removed all soft tissues covering the joint and left the ligamentum ischiofemorale. This band checked the invert rotation of the femur when the latter was in flexion or in extension. To relax this ligament we had to evert the femur. This ligament, .7 cm. long and about one half cm. wide, surrounds very snugly the middle of the femoral neck from the back, so that it looks as if the neck were supported by this band. These facts led us to assume that the eversion of the thigh in fractures of the neck is mainly due to the tension of this ligament, which increases as a result of the hemorrhage around the seat of the fracture. In causing the eversion of the thigh, this ligament is assisted by the muscular fixation of the strong muscles inserting on and about the great trochanter.

In our paper on "Pathogenesis of Skeletal Tuberculosis"[5] we mentioned the fact that the question of the blood supply of the femoral head still represents one of the controversies of opinions of anatomists. It is sufficient to mention that men like Henle, Hyrtl, Karl Langer, Luschka, and Poirier have never come to a uniform opinion as to the nutrition of the femoral head. The enormous clinical importance of this question has often stimulated clinical surgeons to investigate it. That these investigations also did not clear up this question we can judge from a recent series

of three articles by Faltin and Lindgren[6] and a paper by Hildebrand.[7] Faltin and Lindgren claim that ". . . when a medial fracture [of the femoral neck] fails to heal, this is due to inadequate apposition and retention of the fragments and not to the poor blood supply," while Hildebrand thinks a surgical interference in fractures of the neck is advised on account of the peculiarities of the blood supply of the femoral head.

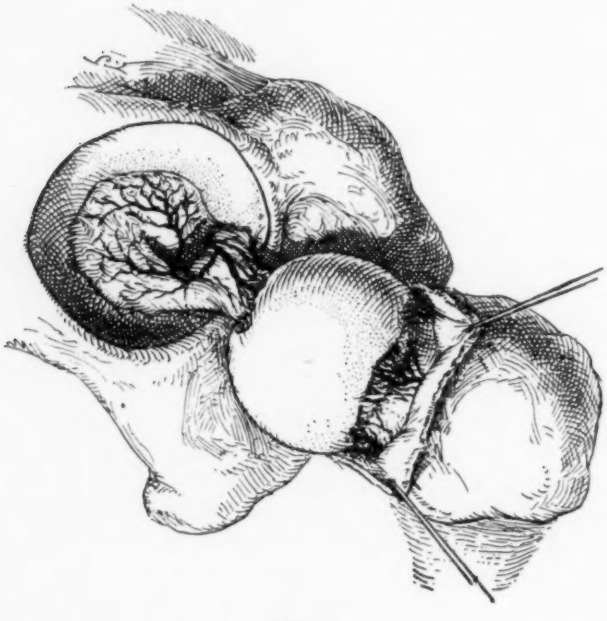

FIG. 7

Drawing from an injected specimen of a new-born, showing the blood vessels running along the superior aspect of the neck towards the femoral head. Note the blood vessels of the round ligament coming from the arteria acetabuli of the ramus posterior arteriae obturatoriae.

We shall attempt here to point out in short the angiology of the head and neck of the femur according to the results of our investigations. Human material alone was used in our work. We made use of fetuses, new-born babies, children, and adults. A special method of injections, gross dissections, stereoscopic roentgenograms, microscopic study of sections, and wax reconstructions of serial sections were the methods used.

The head and neck of the femur of the child and new-born are supplied with blood vessels of four categories:

1. Blood vessels coming from the diaphysis of the femur.
2. Epiphyseal blood vessels.
3. Blood vessels carried by the ligamentum teres femoris.
4. Periosteal blood vessels.

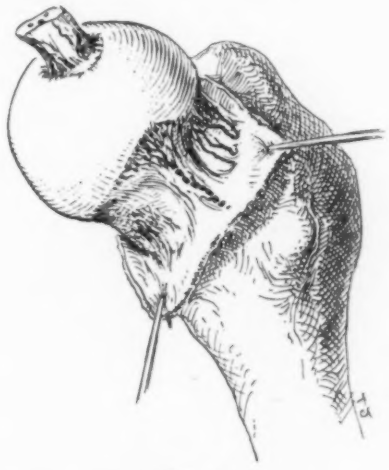

FIG. 8

Drawing from an injected specimen of a new-born, showing the blood vessels running along the anterior and inferior aspect of the neck and entering the head mainly at the "Schenkelhalsspitze." The dotted line represents a blood vessel embedded relatively deep in the periosteum of the neck.

1. To this first group belong the end branches of the femoral nutrient artery. The branches of the superior nutrient artery run in the medullary cavity upward and continue into the neck. It was claimed by Lexer[8] that the diaphyseal blood vessels stop at the epiphyseal junction and do not participate in the nutrition of the head of the femur. In our investigations we frequently met cases where the diaphyseal branches crossed the epiphyseal line on their way to the femoral head. This group of blood vessels, however, plays a subordinate rôle in the nutrition of the femoral head.

2. Under the group of epiphyseal blood vessels we refer to those vessels which enter the head along the edge of the articular surface of the head, i. e., close to the epiphyseal junction. Two main groups of vessels

can be differentiated among the epiphyseal blood vessels. One group comes from the subtrochanteric fossa and enters the head from above. The other group, which plays a prominent rôle in tuberculous involvements of the femoral head, comes from the region about the insertion of the joint capsule on the inferior aspect of the neck, and enters the head at the

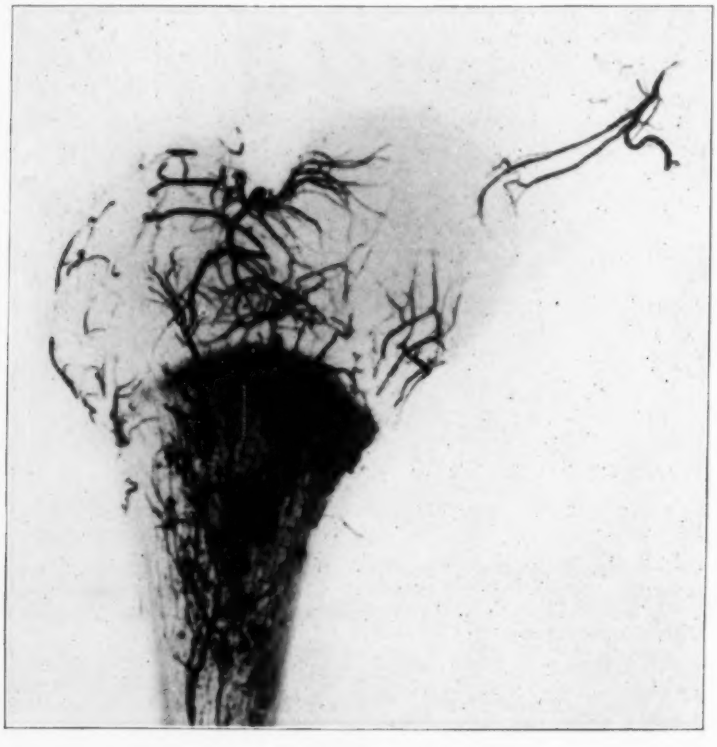

FIG. 9

Roentgenogram of the upper femur of a new-born injected with red lead, showing two main arteries of the round ligament coming from the common trunk with the blood vessels of the pulvinar acetabuli.

lower angle of the femoral head, at the "Schenkelhalsspitze." On their way to the head the epiphyseal blood vessels are embedded in loose areolar connective tissue, a superficial layer of the periosteum covering the neck, so that the vessels run parallel to the neck.

3. The blood vessels carried by the ligamentum teres should properly be regarded as epiphyseal. However, the great difference between these

vessels in the old and young leads us to group them separately. Of the numerous contradictory opinions of anatomists on the ligamentum teres femoris we shall mention only two. Henle, who very appropriately stated that the round ligament of the femur is neither round nor a ligament, thought that the only rôle of this band is nutritive: it carries blood vessels from the acetabulum to the head of the femur. Fick,[9] on the other hand, claims: "Ein grösseres Gefäss ist jedoch noch nie im Band gesehen worden." Our investigations lead us to believe that the importance of the ligamentum teres femoris as a means of carrying blood to the femoral head depends entirely upon the age of the case studied. We have never failed to demonstrate *grossly* in the ligamentum teres of new-born and children two relatively large arteries which have a common trunk with the vessels of the pulvinar acetabuli,—arteria acetabuli of the ramus posterior arteriae obturatoriae. In new-born and children these arteries enter the femoral head and approach the ossification center of the head. In adult life this ligament is of no importance for maintenance of the nutrition of the head. In a considerable percentage of cases in the second half of adult life the ligamentum teres was greatly decreased in size and often it was entirely absent. The narrow capillaries which could be detected microscopically in the ligamentum teres of adults could not be followed up behind the insertion of the ligamentum teres in the fovea capitis femoris. These results of our study lead us to the conclusion that the blood vessels brought to the head of the femur in the ligamentum teres femoris play a certain rôle in the nutrition of the femoral head in the new-born and children, but are of no perceptible importance in the nutrition of the femoral head of the adult.

4. The importance of the periosteal blood supply of the femoral neck has not been sufficiently emphasized in the literature. The old and still current division of fractures of the neck into intra- and extra-capsular shows well that the knowledge of the anatomy of the femoral neck is still very hazy. A careful dissection and microscopic study of the covering of the femoral neck proved to us that the portion of the femoral neck lying within the joint capsule possessed a periosteum which differed very little, if at all, from the periosteum of the extracapsular portion of the neck. That the periosteal blood supply plays an important rôle in the healing of fractures we have pointed out elsewhere.[10] It is plain, therefore, that in a fracture of the femoral neck, extra- as well as intra-capsular, the periosteal blood supply is impaired to the same degree, provided the periosteum is equally torn.

Such is the blood supply of the head and neck of the young femur.

In advanced middle life the conditions are changed in so far as the epiphyseal blood vessels in the ligamentum teres fall short in playing any rôle in the nutrition of the head and neck. The diaphyseal end branches, the periosteal blood vessels, and especially the epiphyseal blood vessels are those upon which the nutrition of the femoral head and neck depend in advanced middle life. In a fracture of the neck, even when no displacement of the fragments takes place, the diaphyseal blood vessels, embedded in the medullary cavity, are torn. The blood channels which still supply the proximal fragment of bone (the head) are the epiphyseal and periosteal blood vessels. And only in cases where at the time of fracture or later on a displacement of the fragments occurs, the periosteum and with it the periosteal blood vessels are torn. The epiphyseal blood vessels are loosely embedded in the superficial layers of the periosteum. They can be stretched and displaced in certain limits without tearing. But if the displacement or angulation of the fragments is beyond these limits, these vessels also tear and the proximal fragment (head) is left without an adequate blood supply.

These are the reasons why we think that the prognosis of a fracture of the neck depends entirely upon the displacement and the angulation of the fragments. We believe impaction as an indicator in prognosis to be important solely because of the fact that in impaction the periosteum and with it the epiphyseal blood vessels are more liable to be preserved intact.

In this paper we have considered only fractures of the neck proper and not the base of the neck. By far the greater number of fractures of the upper femur in old persons belong to fractures through the base of the neck. There they follow a fall on the hip (trochanter-lateral compression) and are frequently accompanied by impaction of the narrow proximal portion into the broad distal fragment. In these cases the fracture does not differ much anatomically and physiologically from any other fracture of the femur in the old. Union in these fractures is not a rarity. But if fractures through the neck proper (from vertical compression) occurred in old persons as frequently as fractures through the base of the neck (lateral compression), non-union of fractures of the femoral neck in old persons would be incomparably more frequent.

CONCLUSIONS

The architecture of the head and neck of the femur explains the exact site of the fracture line both in vertical and lateral compression of old and young.

The pathognomonic position, eversion of the femur with the fractured neck, is the result of the action of the ischiofemoral ligament combined with muscular fixation.

The question of healing of fractures of neck is entirely dominated by the difference of nutritional conditions in different types of fractures and in various ages of the patient.

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THE BIFURCATION OPERATION FOR THE TREATMENT OF IRREDUCIBLE DISLOCATIONS OF THE HIP JOINT*

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During a recent visit to the Lorenz Orthopaedic Clinic in Vienna the writer had the opportunity of observing the end results in a number of patients upon whom the bifurcation operation had been performed for the

FIG. 1

Anteroposterior view illustrating subluxated head of femur with stretched capsule.

relief of irreducible dislocations of the hip joint. These results were so gratifying that he resolved to attempt the procedure on his own cases upon his return. The patients operated upon presented irreducible cases—

*Presented at the Annual Meeting of the American Orthopedic Association, May, 1925.

either those upon whom bloodless reduction was unsuccessful, or those neglected cases upon whom bloodless reduction could not be performed because they had passed the favorable age limit. Some of the cases were congenital, while others were either pathologic or paralytic subluxations.

FIG. 2
Lateral view illustrating line of osteotomy with relation to acetabulum.

This paper consists of a report of five patients upon whom the above procedure was performed, and, as in the cases observed in Vienna, all of them have presented very gratifying results. Four of the dislocations were unilateral and one bilateral. The first patient was operated upon in June, 1923, and the last in November, 1924. The age of the youngest was thirteen years and of the oldest, twenty-one, four being females, and one, male.

The technique of the bifurcation operation is as follows: The buttock on the side to be operated upon is elevated sufficiently by a sand bag to make the greater trochanter easily accessible; the upper end of the lateral surface of the thigh is prepared and draped in the usual manner. After studying the radiogram to determine the relation of the displacement of the head of the femur to the acetabulum (Fig. 1), an incision five inches in

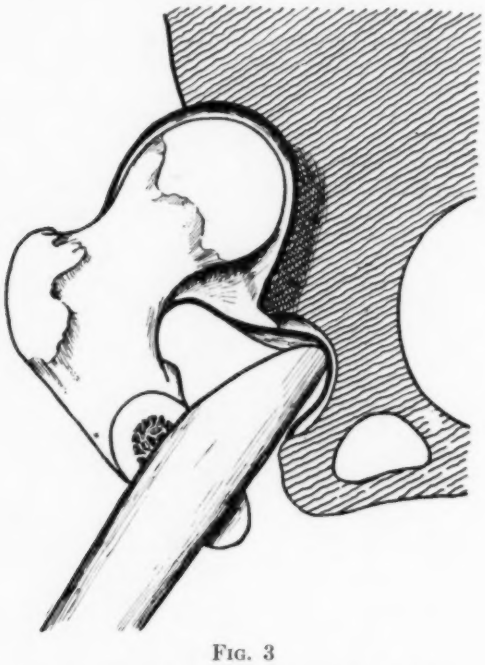


FIG. 3

Anteroposterior view. Distal end of femur manipulated into acetabulum with inferior portion of capsule displaced medially. The proximal end of femur is also displaced medially.

length is made along the upper end of the lateral surface of the femur, at the level of the acetabulum, and the femur is exposed by bloodless dissection. An oblique osteotomy is performed on the lateral plane of the femur at the level of the center of the acetabulum, with the upper end of the osteotome pointing anteriorly (Fig. 2). Under no circumstances must the adductors be divided, for they assist in maintaining the distal end of the femur in the socket. After the osteotomy has been completed, the patient

is placed supine upon the table and the end of the femur is manipulated into the acetabulum, in a manner very similar to the bloodless reduction of hip-joint dislocations (Fig. 3). The proximal end of the femur is also drawn toward the acetabulum by means of the contraction of the muscles attached to the trochanters, and the osteotomy ends now present a fork-like appear-

CASE 1

Lumbar lordosis before operation.

ance. Inasmuch as the osteotomy has been obliquely performed, this replacement is accomplished by means of torsion of the osteotomy ends, thereby assuring the contact of two raw bone surfaces with one another. This method was devised by Hass, and is an improvement over the old original osteotomy of Lorenz, who performed an oblique sagittal osteotomy with the osteotome held in the horizontal plane. The difficulty with this

procedure was that as the distal end was forced up into the acetabulum the proximal denuded surface of the femur occasionally came in contact with a portion of the distal end which was not denuded of periosteum. As a result the osteotomy ends did not unite. In the improved method of Hass, union of the fragments is certain to take place. After the distal

CASE 1
After operation. Absence of lumbar lordosis.

end of the femur has been manipulated into the acetabulum the skin incision is closed and the patient adjusted on the fracture table with the thigh abducted at an angle of 30 degrees and in the horizontal plane. The manipulated limb must not be fixed to the fracture table, but should be held firmly by an assistant to insure that the reduced femur is held in place. In this position a hip spica plaster-of-Paris bandage is applied from the axillae to the toes.

As soon as practicable, another radiogram is taken in order to determine the position of the distal end of the femur in the acetabulum. If the reduction has been unsuccessful the plaster bandage should be removed under anesthesia, the distal end of the femur again manipulated, and the plaster-of-Paris spica re-applied. The hip spica remains in position for three months, although that portion of the plaster bandage extending from a

CASE 1

Flexion of hip following bifurcation operation.

point above the knee down may be removed from four to six weeks after the operation, and massage and active and passive motion can be instituted for the knee and ankle joints. Immediately after the entire plaster bandage has been removed, the patient is urged to walk with the aid of crutches and to bear weight upon the affected limb. Active motion is encouraged and the crutches discarded as soon as possible. A lift is applied to the shoe on the affected limb to compensate for the shortening.

In bilateral cases it is advisable to do each of the two hips in two sittings, although both may be done at once. Every reasonable care is exercised to maintain reduction in the first hip while proceeding with the second. It is also more difficult to hold the hips in place when applying

CASE 1

After bifurcation operation. Absence of Trendelenburg symptom.

the double plaster spica. In bilateral cases the angle of abduction is limited to not more than 20 degrees, otherwise difficulty may be encountered in adducting the thighs after removal of the plaster.

A question that is very frequently asked as regards the technique of the operation is: "At what level should the osteotomy be performed?" As previously stated, the radiogram of the dislocated hip joint is carefully

studied before the operation, and the relation of the dislocated head to the acetabulum thus determined. The osteotomy is performed at such a level that the middle point of the osteotomy line is on the same plane as the center of the acetabulum. This point may be intertrochanteric in some cases, in others subtrochanteric, while in still others the osteotomy may extend into the lesser trochanter.

It has been suggested that ankylosis of the hip joint may result, as it

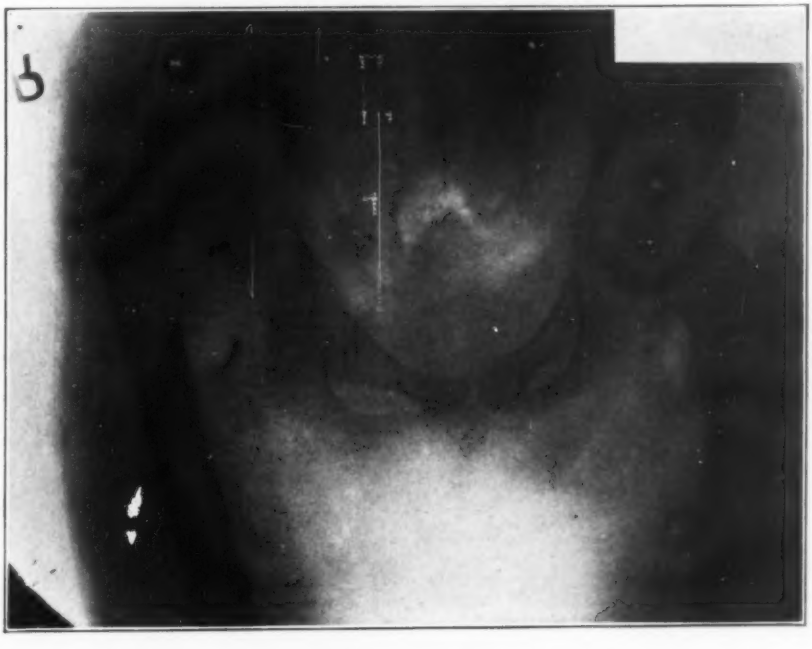


PLATE NO. I. CASE 1
Congenital Dislocation Hip.

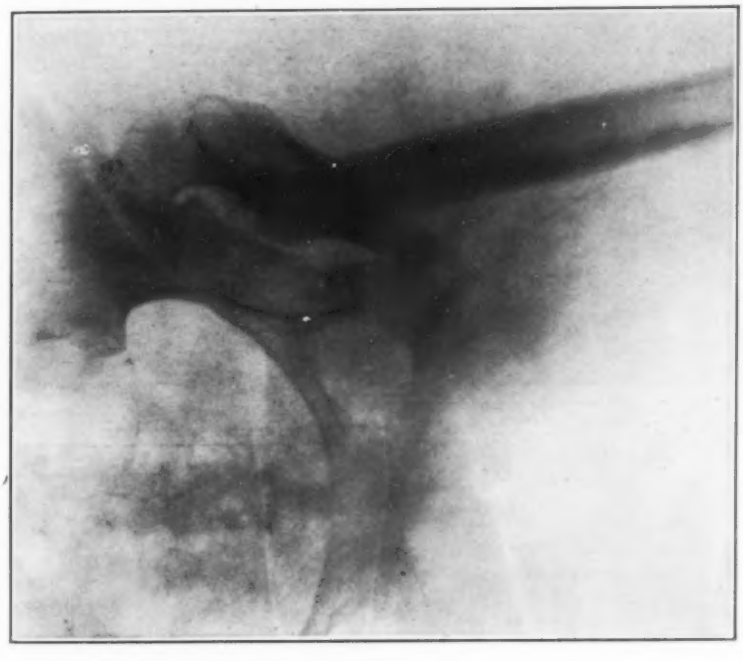
does in some of the more radical open operations for the replacement of dislocations of the hip joint. When we consider the relation of the capsule of the hip joint with the head and acetabulum, we know that that portion of the capsule which is attached to the superior rim of the acetabulum and to the superior portion of the neck of the femur becomes stretched over the head of the femur when the head is displaced upward (Fig. 1). Obviously that portion of the capsule which is attached to the inferior portion of the neck of the femur is distended across the entire acetabular cavity.

Frequently this inferior portion of the capsule is adherent to the superior rim of the acetabulum—thus sealing it over completely. The osteotomy which is performed is, of course, extra-capsular, and when the distal end of the femur is manipulated into the acetabulum it forces this distended inferior portion of the capsule into the acetabulum behind it (Fig. 3), this

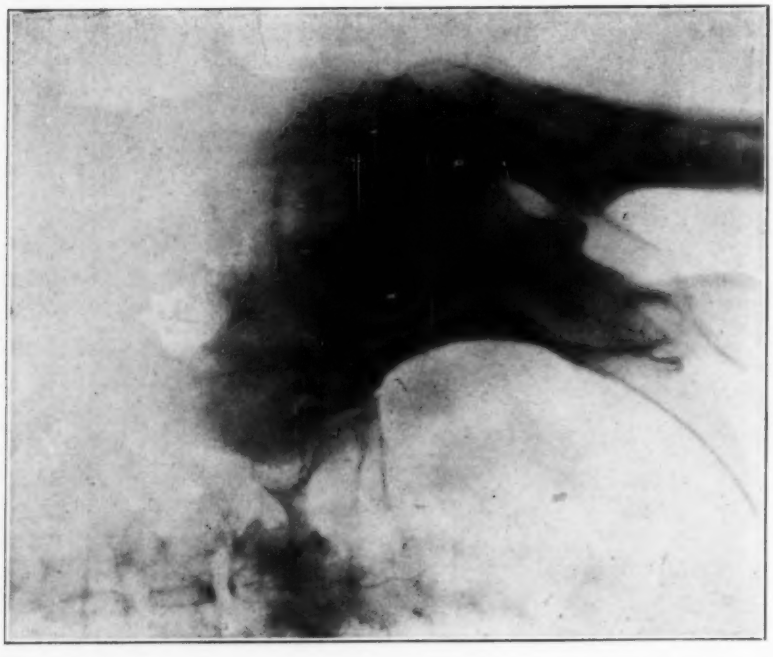
CASE 1. No. 2
Bifurcation operation right hip. Distal end of femur manipulated into acetabulum. Plaster spica applied.

portion of the capsule acting as an interposing membrane, which prevents ankylosis from taking place. On the contrary, these patients have a range of flexion of the hip joint from 75 to 90 degrees. There is also a fair amount of abduction and adduction, with limited circumduction, so that they obtain a satisfactory functional result, and in some cases manage

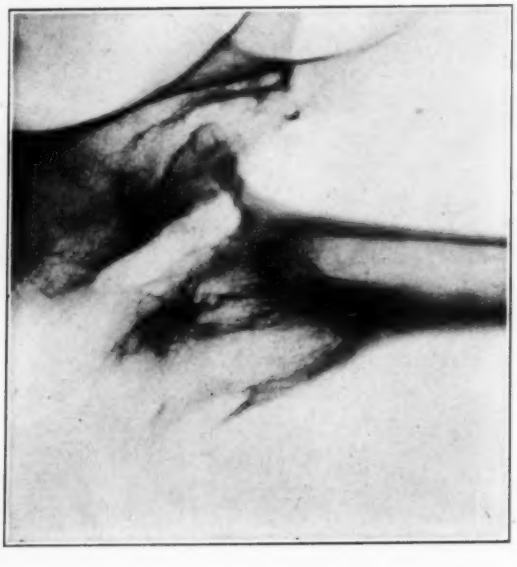
CASE 2. No. 1
Dislocation of hip following suppurative arthritis.



CASE 1. No. 3
Hip spica removed. Distal end of femur in acetabulum.
Callus formation present.



Case 3. No. 1
Paralytic dislocation of head of right femur.



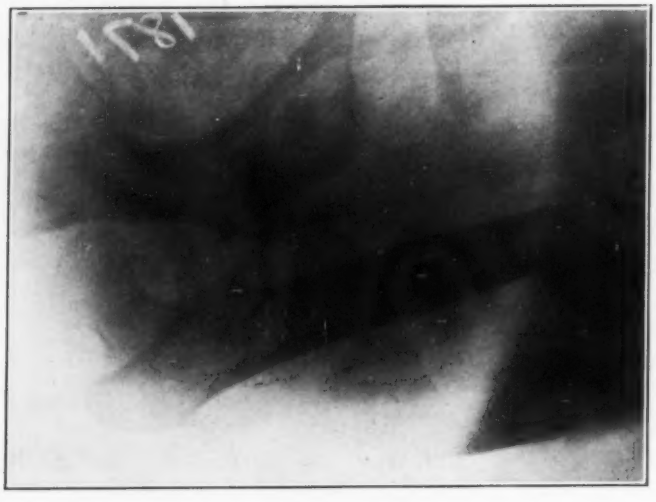
Case 2 No. 2.
Following bifurcation operation with extensive callus formation at site of osteotomy.

to get about with no appreciable limp. The Trendelenburg sign, which is diagnostic of all dislocations of the hip joint, particularly in bilateral dislocations, is completely overcome after the bifurcation operation. This

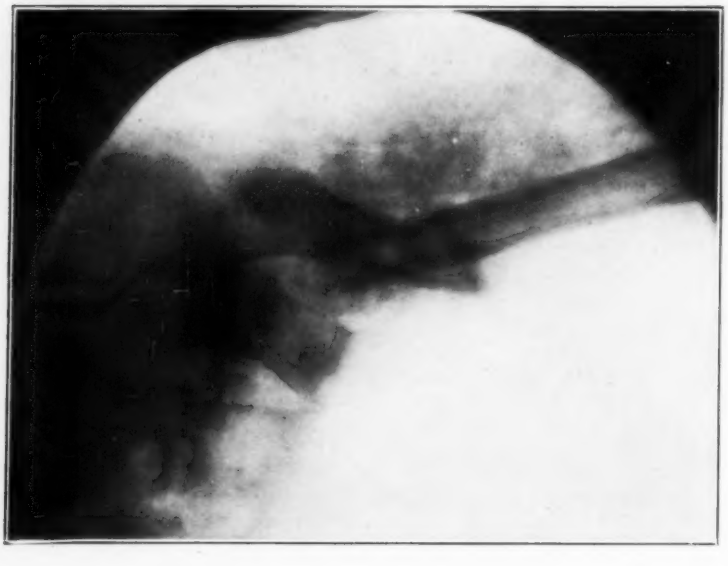
PLATE No. I. Case No. 3. No. 2

Bifurcation operation, right hip and distal ends of femur manipulated into acetabulum. Hip spica applied.

is due to the fact that the hip joint has resumed its normal physiologic functions of maintaining the anteroposterior equilibrium of the body, and serving as a fulcrum for the muscles attached to the trochanters and upper end of the femur.



Case 4. No. 1
Congenital dislocation left hip.



Case 3. No. 3
Plaster spica removed. Distal end of femur in acetabulum and callus formation.

Does the operation increase the shortening already present? Inasmuch as the osteotomy is performed at the level of the acetabulum it is obvious that very little additional shortening will result, although it is conceded that there may be a very slight increase in shortening in some instances. In the bilateral cases, this is, of course, of very little consequence, but in unilateral cases it may be considered an objection, although

CASE 4. No. 2

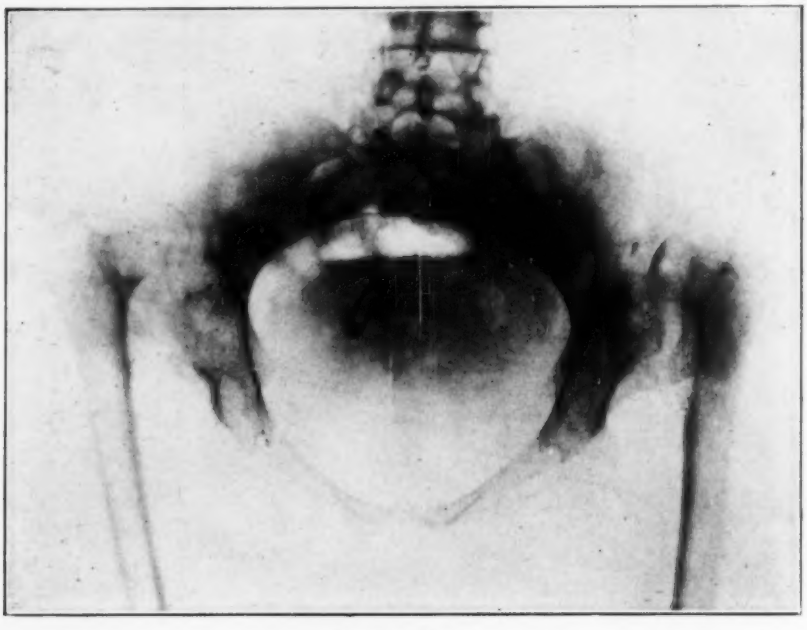
Bifurcation operation left hip with distal end manipulated into acetabulum.

a minor one. The operation certainly does not overcome any shortening which is present, although this is easily overcome by an elevated shoe or by shortening the long leg.

The operation is contra-indicated where the acetabulum is very shallow, and in those patients in whom a satisfactory false acetabulum has formed in close proximity to the true one.

Theoretically the ideal operation is one which replaces the femoral head in the acetabulum, overcomes the shortening, and produces a movable

hip joint. Many excellent results have been reported by Dickson, Gill, Galloway, and others. On the other hand, many of the results have not been quite so satisfactory, and in some instances ankylosis of the hip joints has occurred. There have been some unfortunate accidents—such as permanent injuries to the muscles and nerves of the thigh—due to the excessive traction required to replace the head in the socket. Moreover, operations of this type, whether they be merely for replacement of the



CASE 5. No. 1
Bilateral congenital hip dislocation.

head or arthroplasties, are radical procedures which necessitate extensive dissection into the hip joint through incisions such as the Kocher or Smith-Petersen incisions. These operations require considerable time for their performance, and in some instances are a rather severe shock to the patient. The bifurcation operation, on the contrary, is entirely extra-articular, and a comparatively subcutaneous procedure which is accompanied by practically no shock, requires very little time, and does not result in ankylosis.

There have been other methods suggested, such as constructing a false acetabulum at the site of the luxated femoral head. Let us consider

for a moment the cause of the deformity in hip joint dislocations. In fractures of the shaft of the femur the only deformity which may occur is shortening, but this is easily compensated by an elevated shoe. In hip joint dislocations, in addition to the shortening, there is lordosis due to the fact that the head now occupies a position superior and posterior to its

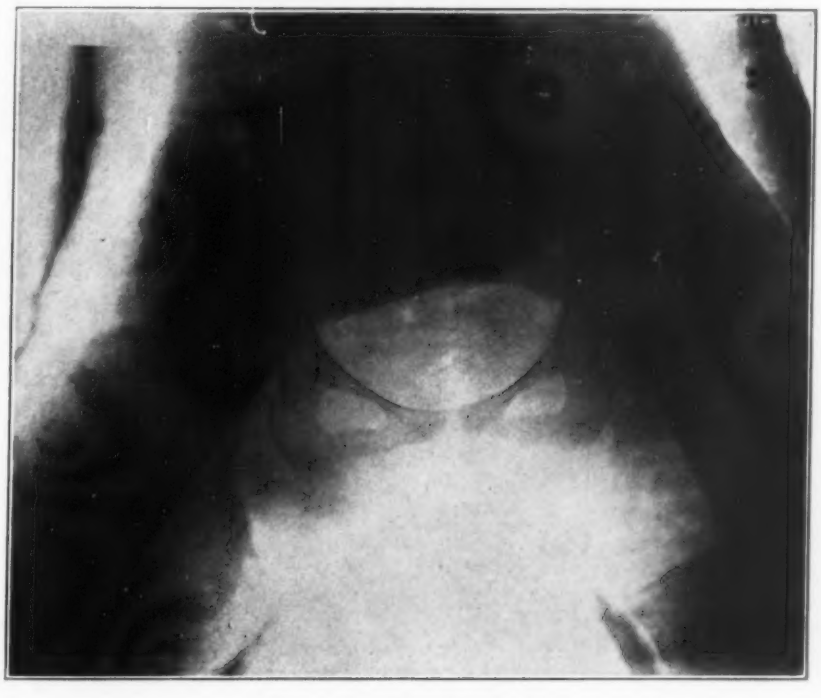


PLATE No. I. Case No. 5. No. 2

Bilateral bifurcation operation and distal ends of femur manipulated into acetabula. Bilateral hip spica applied.

normal location, with resulting disturbance of the equilibrium of the body in the anteroposterior plane.

It is obvious, therefore, that any procedure designed to reconstruct the hip joint should have for its primary object the restoration of the anteroposterior equilibrium of the body, in order to overcome the lordosis. This necessarily should restore the fulcrum of the hip joint to the acetabulum.

CONCLUSION

The bifurcation operation is indicated in all types of irreducible dislocations of hip joint, (a) in patients upon whom bloodless reduction has been unsuccessful, or (b) who have passed the favorable age limit. Any procedure designed to reconstruct the hip joint should have for its primary object the restoration of the anteroposterior equilibrium of the body in order to overcome the lordosis.

CASE 5. No. 3

Plaster spica removed. Distal osteotomy ends in acetabulum. Evidence of union around osteotomy ends.

The operation has been successfully employed in cases of ununited fracture of the neck of the femur.

Although the successful replacement of the head into the acetabulum is the ideal procedure, nevertheless, the bifurcation operation achieves equally good results by a procedure which is extra-articular, is attended with practically no shock, requires a very short time for its performance, overcomes the lordosis, and produces a movable hip joint. There may be a

slight amount of increased shortening, which is negligible and easily overcome.

CASE REPORTS

CASE 1. J. J. Aet. 13; female. Congenital dislocation of right hip joint. Had never received any form of treatment. She walked with a decided limp. There was a positive Trendelenburg symptom and a marked lordosis.

A Lorenz bifurcation operation was performed in June, 1923, with an extremely satisfactory result. There is 90 degrees flexion present in the right hip, with a slight amount of abduction and circumduction. Both the lordosis and Trendelenburg symptoms are completely overcome. Patient has no discomfort, walks with no limp with aid of elevated shoe.

CASE 2. M. C. Aet. 19; male. At the age of four had an acute suppurative arthritis of the hip, which resulted in the complete destruction of the neck and nearly all of the head of the femur. There was a shortening of three inches. Trendelenburg symptom was present. He walked with a bad limp. Motion in hip joint limited to about half of the normal range.

Lorenz bifurcation operation was performed in December, 1923, and the result has been very satisfactory. He is able to walk much further and with less difficulty, and has been at work every day for nearly a year. The sharp fragment of the lower portion of the femur closely approximates the small remaining portion of the head of the femur, and even appears to have formed a union with it. The patient is greatly pleased with the result.

CASE 3. E. L. Aet. 21; female. Presents a history of having had infantile paralysis involving both extremities at the age of three years. After apparent recovery, patient developed a severe limp of the right leg. There was two inches shortening, a marked lordosis, and the Trendelenburg symptom present.

Bifurcation operation performed February, 1924. Lordosis and Trendelenburg symptom now absent. Patient has very satisfactory motion in hip joint, walks without limp or discomfort, and is very much pleased with result.

CASE 4. T. G. Aet. 16; female. Congenital dislocation of left hip joint with coxa vara. Reduction had never been attempted. Patient complained of pain in left hip after prolonged walking or standing. There were two inches shortening, with consequent limp, a marked lordosis, and positive Trendelenburg symptoms.

Lorenz bifurcation operation performed July, 1924; lordosis and Trendelenburg symptoms entirely overcome. There is about 80 degrees flexion of the left hip. Patient walks long distances without pain or limp, and has a very satisfactory result.

CASE 5. E. P. Aet. 17; female. Bilateral congenital hip dislocation. Received treatment in hands of competent surgeons in early life, but reduction was unsuccessful. Had two and one-half inches shortening, marked lordosis, positive Trendelenburg symptoms of both hips. Limp was very characteristic of bilateral dislocation.

Bifurcation operation performed November, 1924. Both hips treated at one operation. Lordosis and Trendelenburg symptoms now entirely absent. Has very satisfactory motion in both hips, and now walks with practically no limp. Result in this bilateral case is exceedingly satisfactory.

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DISCUSSION

DR. FRANK D. DICKSON, Kansas City, Mo.: I feel rather incompetent to discuss this paper as I have never done one of these operations and have had very little opportunity to observe the results. I agree thoroughly that the thing to do in an irreducible dislocation of the hip is to stabilize it by some method. I agree that the point of weight-bearing must be moved forward in order to obtain success with any method. I am not willing to admit that the bifurcation method is the best means of doing this. I did have an opportunity of seeing two of these cases in Cleveland last November, and one of the two I examined very carefully. The result of my examination led me to draw the following conclusions regarding that particular case: First, there was apparently considerably more shortening than I usually find in congenital dislocation of the hip. Second, this girl had a tremendous limitation of motion in the hip-joint. Nearly all her movement was in the lumbar spine. The hip was solid enough, but it was quite certain that there was a distinct limitation in motion to my examination. That was the only conclusion I could draw from that one case. The other patient certainly walked very well. I did not have a chance to examine her, but she walked with but a slight limp. We know that a stiff hip is a pretty easy thing to disguise and that a person can walk quite well with a stiff hip, so that it might be that this patient also had some limitation of motion in the hip. Those were the only two cases I have ever seen. One walked very well and the other had considerable limitation of motion. Of course, I think that any method that approximates the normal is most desirable; for that reason I believe that pushing the head forward and turning down a flap is preferable to this type of operation. I hope some one who has had more experience than I will discuss this paper because I do not feel that I am in a position to discuss it on the basis of experience.

DR. F. J. GAENSLEN, Milwaukee, Wis.: My first acquaintance with this operation dates from a visit with Dr. Ludlow in 1922. He showed me a boy of twelve years, on whom he had performed the operation bilaterally; also pictures of this patient before operation. The lordosis had completely disappeared and his walk was excellent, I can vouch for that. I do not remember what range of motion he had. I think it is wise in reporting end-results in such cases as Dr. Reich reports to state just how many degrees of motion the patients had in the various directions rather than to say that he walks well or that he can step up on a platform.

There is no question that improved stability is obtained, but it is also true that some shortening and limitation of motion result. If you will examine the slides shown on the screen it will be quite evident that some shortening has taken place. This is to be expected and is unavoidable.

I have operated on two cases. The first was a boy of eleven with bilateral dislocation of the hips, one side only being operated on. There was so much limitation of motion that for the present I am disinclined to follow it with an operation on the other side. I am not sure that it is wise to operate on these bilateral cases. If the other side were operated on in this case and the same degree of limitation of motion were to result, I am afraid his condition would not be much improved. The very considerable abduction will assist in compensating for the additional shortening. The apparent malposition in the roentgenograms after operation is certainly very disturbing.

The second case was a young woman of twenty-five with a unilateral dislocation. This case is too recent to know what the end-result will be.

I have not made up my mind as to the merits of this operation. I believe that in the future I would prefer to do the operation devised by Dr. Dickson. This would appear to insure a greater degree of motion and less shortening, while the lordosis can be corrected by a forward setting of the head.

Dr. John Ridlon, Chicago: The first picture of the first patient showed a marked lordosis. The second picture was taken obliquely and showed only a little lordosis. The third picture, showing the range of motion at the hip, showed about the same lordosis as the first picture showed.

Dr. M. N. Smith-Petersen, Boston, Mass.:

1. Dr. Reich objects to the extensive dissection of the supra-articular subperiosteal approach to the hip joint. It may be extensive, but it is carried out along structural planes, with a minimum loss of blood, and is not shocking to the patient. It is quickly performed and gives a complete exposure of the hip.

2. I fail to see how a bifurcation operation is going to compensate for the actual loss of length. The abduction obtained by this operation cannot compensate sufficiently to eliminate a limp. I think, therefore, that the term "no limp" is misleading.

3. The operation has been undertaken in children and young adults who are able to compensate for the deformity, but as the years go by there is loss of elasticity and proliferative changes, which are bound to give rise to symptoms.

Dr. R. S. Reich, Cleveland, O. (closing the discussion): As I said in the paper, the operation does not attempt to accomplish an ideal reposition of the hip joint. The operation is performed if we are sure all the conditions are favorable for that type of operation. You and I have all seen failures in any operation that has attempted to replace the femoral head in the acetabulum.

As to the presence and absence of lordosis in the photograph I showed, I am sure there are a number of gentlemen here who saw this case at the meeting of the Central States Orthopaedic Society in Cleveland and I think they will vouch for the absence of lordosis at that time in the illustration of the case presented here.

As to the Smith-Petersen incision, I want to impress upon you the fact that this operation is practically a subcutaneous and extra-articular procedure and that consequently there cannot be as much shock as in an operation which requires a radical resection into the hip-joint by any type of approach.

As to the shortening mentioned by Dr. Gaenslen, we do not deny that there might be increased shortening in spite of the fact that you might make the osteotomy in such a way that the upper end of the acetabulum is opposed to the upper end of the distal fragment, but as time increases there might be some shortening as the upper end of the distal fragment becomes worn down. That can be easily compensated for by an elevated shoe. I would be glad to have the gentlemen see the cases we have.

The only way to determine motion is to fix the pelvis so as to determine the amount of flexion present. With the exception of the last case, in those I have reported I have seen anywhere from 75 to 90 degrees of flexion with the pelvis fixed, so there was no opportunity to turn the pelvis forward.

THE RESIDUAL PARALYSIS AND DEFORMITY OF ANTERIOR POLIOMYELITIS*

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INTRODUCTION

In order to study the extent of the paralysis and the subsequent deformity following anterior poliomyelitis, 350 histories from the files of the Mayo Clinic from January, 1918, to January, 1923, were reviewed. Approximately fifty per cent. of the cases have been personally observed by the author; and of these, four cases examined in 1922 will be reported in detail. Of the 350 cases, 257 were treated surgically and 113 were treated medically. One hundred and eighty-four of the patients were males and 166 were females.

THE ACUTE ATTACK. In reviewing the histories it is interesting to note and compare the story of the acute onset as told by the patient or his parents. The incidence of the acute attack is greatest in the first three years of life. Forty-four per cent. of our patients were paralyzed before their third birthday; adults, however, are not immune. The average duration of the paralysis when applying for treatment was 8.4 years.

The geographical distribution naturally follows very closely that of the general registration of the clinic. Most of the patients come from the rural districts of the Middle Western portions of the United States and Canada. The majority of our cases were of the endemic type. A positive statement of an epidemic in the community was obtained in but fourteen cases. There were five instances of two cases in the same family.

The initial paralysis involved both legs in 37.5 per cent. of the cases. Other combinations in the order of frequency were all four extremities, the left leg alone, the right leg alone, one arm and both legs, and hemiplegia.

Trauma as an etiologic factor was mentioned thirty-six times. Examples such as the child falling and having to be carried home are more apt to be a symptom than a cause of paralysis. Four of the cases, however, seem to indicate the cause-relationship of injury. In two of the cases

* Abstract of thesis submitted to faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Orthopaedic Surgery, June, 1924.

observed by the author the paralysis developed after a fracture and was limited to the traumatized extremity. This suggests that an injury such as a fracture, or the inactivity of the limb due to fixation, may so lower the resistance of the corresponding portion of the spinal cord that the virus may more easily gain entrance.

THE PERMANENT RESIDUE. The prognosis during the acute stage should always be guarded. If life is spared improvement will probably

FIG. 1 (Case A402992). Bilateral deltoid paralysis.

occur. But after the acute attack many patients are helpless for a long period of time. Thirty-five of our patients did not walk until after the first year; eleven did not walk for the first two years; six did not walk for three years; four did not walk for four years; one for five years; one for eight years; and one for thirty years. When brought to the Clinic forty of them were unable to stand even with the aid of crutches. Seven crawled on their hands and knees; twenty-three wore a brace, and forty-seven used crutches. Twenty cases only had sufficient power to enable them to walk without a limp. In view of this it is encouraging to remember that Dr. Lovett has said that in all of his experience he has seen only two or three cases which were so badly crippled that locomotion could not be accomplished

in some manner. The limp, which was the chief complaint in forty-four per cent. of the cases, was usually due to one of three causes: shortening of the affected limb, weakness of the quadriceps muscle, or weakness of the abductor muscles of the hip. Deformity of the feet and legs was the second most frequent complaint. Thirteen patients complained of pain due to the strain of improper weight-bearing. One child was brought

FIG. 2 (Case A406805). Flexion abduction deformity of left thigh; lateral view.

because a diagnosis of congenital dislocation of the hips had been made elsewhere, and one girl came because of a malignant tumor developing in a paralyzed arm.

At the time of a patient's first examination and on subsequent visits, a muscle test was made and recorded. The manual examination was used as a routine, the degree of power being graded arbitrarily on the basis of 0 to 4. Zero indicates normal strength; *one* indicates strength sufficient to enable the muscle to act against gravity plus some resistance; *two* indicates power to act against gravity but not with resistance; *three plus* indicates

a muscle acting only when gravity has been removed; *three minus* indicates a contraction insufficient to move the neighboring joint, and *four* indicates complete paralysis.

The muscles of the back were paralyzed in sixty-four cases, and the abdominal muscles in 147 cases. In the arm the anterior deltoid was the

FIG. 3 (Case A394284). Paralytic scoliosis.

muscle most frequently affected; the posterior deltoid was next. The triceps was involved more often than the biceps. In the hand the muscles of the thumb and the interossei were most often paralyzed. It seems to be the rule, as pointed out by Lovett,[3] that in the upper extremity the most severe paralysis occurs in the proximal part of the limb. In the leg, however, the most severe paralysis occurs in the distal portion, among the muscles of the foot. Tubby considers the peroneal muscles the most

severely or frequently affected. Lovett groups them in order of frequency thus: the anterior tibial, posterior tibial, extensor proprius hallucis, extensor digitorum longus, peronèals, and gastrocnemius.

In this series the rate of frequency closely follows that of Lovett: the anterior tibial was paralyzed in 460 cases, counting the left and right feet separately; the posterior tibial in 443 cases; the gastrocnemius in 406 cases; the extensor longus digitorum in 377 cases; the peroneal in 374 cases, and the extensor proprius hallucis in 297 cases.

In the thigh, the extensors of the knee were more often affected than the hamstring group. The sartorius and the tensor vaginae femoris were seldom involved.

The proportion of complete to partial paralysis is also greater in the leg than in the arm. The anterior tibial was graded *four* in thirty-eight per cent. of the cases in which it was paralyzed. Tables 1 and 2 show the distribution and degree of the paralysis.

In practically every case in which there was paralysis of a limb there was also lowering of temperature, cyanosis and atrophy. The atrophy was either trophic or due to non-use. The greatest variations were seen when one limb had been paralyzed from childhood. In ischemic paralysis Groves attributes the shortening to a lessened blood supply, as the growing ends of the bones are supplied by muscular branches of the main artery. This may also apply in the shortening in infantile paralysis. The greatest amount of shortening encountered was in the case of a boy, aged thirteen years, who had become paralyzed in infancy. The left leg was 15.5 cm. shorter than the right leg. Ten centimeters was the greatest variation in circumference of the thigh; 14.3 cm. in the calf; 4 cm. in the upper arm, and 5 cm. in the lower arm.

The incidence of paralytic deformity was slightly greater in the left leg than in the right. The incidence decreased in the following order: deformity of both feet was the next most common; the trunk and left leg next; and the trunk and both legs fourth. However, there may be almost any combination of deformities of the spine, one or both upper extremities, or of one or both lower extremities.

Flexion and abduction deformities were common at the hip-joint. Flexion deformity and hyperextension of the knee occurred in about equal proportions. When flexion occurred it was often associated with genu valgum and subluxation of the tibia. Genu varum was seen in but one case. Unequal muscle pull may cause torsion of the tibia on its long axis.

Deformities of the feet outnumber by far all other types of deformity. Talipes equinus was the most common. This occurred either alone or

with other deformities in 142 cases. In twenty-nine cases it was bilateral. Valgoid deformity, corresponding to the high incidence of paralysis in the tibial group of muscles, ranks second, and talipes varus, calcaneus, and cavus in the order named. The chief contractures in the upper extremity were caused by the teres and pectoral muscles at the shoulder and by the flexor tendons of the wrist and fingers.

Scoliosis in infantile paralysis may be caused by paralysis of the abdominal or spinal muscles, by paralysis of the shoulder, or by inequality in length of the legs. It was present in 110 cases (31.4 per cent.), which agrees with Lovett's figures,[4] as he says that scoliosis is present in thirty per cent. of old cases. Lordosis was present in fifteen cases, and torticollis in one. There were six instances of subluxation of the shoulder, and six of paralytic dislocation of the hip.

Treatment. In the treatment of infantile paralysis the prevention of deformity must begin in the acute and subacute stages. Splints and braces should be used when needed. In the early treatment rest is of prime importance. Massage, heat, and muscle training, carefully given and persisted in, insure the maximum recovery to muscles whose nerve centers have not been permanently destroyed. Operations are performed only if the paralysis has existed for some time. Approximately 350 operations, or combinations of operative procedures, were carried out in the 237 surgical cases in the series. The operations may be divided into three groups: (1) operations to correct deformities, such as tenotomies, fasciotomies, and osteotomies; (2) operations to correct deformity and also stabilize the limb, chiefly Whitman's operation of astragalectomy and various types of arthrodeses of the tarsal joints; and (3) operations to increase the function of the limb, such as tendon transplantations at the foot and knee. In this series there were two tenodeses at the ankle, four arthrodeses of the knee, and one of the shoulder; there were no tendon transplantations in the forearm. Besides these corrective measures, a leg was amputated in one case on account of extensive paralysis below the knee.

REPORT OF CASES

Case 1. (A402992.) A boy, aged ten years, was examined at the Clinic August 28, 1922. A year before he had had general malaise and loss of appetite. August 22, 1921, he had complained of pain in his neck; August 23, he vomited; August 24, he had a moderate fever, and on August 25, a fever of 105° which lasted for three or four days. He became delirious and then comatose. A spinal puncture was made August 27 by the attending physician, who reported the findings negative. August 28, when the fever subsided and the patient regained consciousness, it was found that he could not

move his left leg and could move the right leg and arms but very little. There were no known cases of poliomyelitis in the vicinity.

At the time of examination the patient still had difficulty in running and in climbing stairs because of weakness in the left thigh. There existed bilateral deltoid paralysis, scoliosis, and flexion contracture of the right hand. Routine treatment, consisting of massage and exercises, was outlined, and the patient instructed to return in one year for observation. Arthrodesis of at least one shoulder may be necessary later (Fig. 2).

CASE 2. (A268056.) A girl, aged seven years, was examined at the Clinic October 7, 1921. The child had complained of sore throat and pain in the abdomen on September 1. Her face was flushed, but the mother thinks she had no fever at that time. She remained in bed, resting well that night and the following day. The third day the pain in the abdomen and back was more severe. On the morning of September 4 she felt much better. Later in the day the pain involved the right leg. At 4 P.M. she attempted to get out of bed, but the right leg would not support her weight and she fell to the floor. Rosenow* was called in consultation September 5, eighteen hours after the onset of paralysis.

As the child had had numerous attacks of bronchial asthma, the precaution was taken of desensitizing with a small injection of serum, and of dividing the total amount of serum given into two doses of 10 cc. each. The first injection was made September 5 at 10.30 A.M. The temperature was 101.4, and the pulse rate 132. September 6 there had been no extension of the paralysis and consequently no serum was given. September 7 the paralysis began to increase, involving successively the right arm, the left leg, and the left arm. September 8, 20 cc. of serum was injected intravenously. September 9 there had been no extension of the paralysis, and a slight improvement in the paralyzed limbs was noted. September 10 the temperature became normal, and the paralysis was improving.

At the time the patient was examined at the Clinic there was extensive paralysis of the lower extremities, abdominal and spinal muscles, persistent muscle tenderness, foot drop, and beginning scoliosis to the left. The foot was supported at right angles, and the patient was placed on a Bradford frame and kept recumbent until March, 1922. In spite of the recumbent position, flexion deformity of the right hip developed from contracture of the tensor fasciae femoris. The mother was instructed in the exercises necessary for muscle training. Frequent examinations have shown a gradual recovery of power in the left leg, but a less marked improvement in the right. January 15, 1923, the patient began to walk with the aid of crutches, an abdominal corset, a caliper brace on the right leg, and a jointed knee brace on the left. Two further points of interest in this case are: the great increase in weight following inactivity, and the marked severity of the recent attacks of bronchial asthma, probably due to paralysis of the accessory muscles of respiration.

CASE 3. (A406805.) A girl, aged four years, was examined at the Clinic October, 1923. In the fall of 1918, at the age of six weeks, the child suddenly became ill, and cried as if in pain. The patient was constipated and had fever for two or three days. Paralysis was noted on the third day. It involved all four extremities, but was complete only in the left leg. Improvement began after four weeks, being apparent first in the right arm.

* Dr. Rosenow has kindly allowed me to quote his notes as to the administration of antipoliomyelitis serum and the patient's reaction to it.

Four years later when the patient was examined at the Clinic, the strength in her arms was practically normal. Her abdominal muscles were weak and there was extensive paralysis in both legs, with loss of the patellar and Achilles reflexes. There was a left total scoliosis, and flexion and abduction deformity of the left thigh (Fig. 3). A Soutter operation performed October 10, 1922, corrected the flexion deformity and greatly improved the gait.

CASE 4. (A394284.) A boy, aged thirteen years, was examined at the Clinic June 10, 1922. October 23, 1916, at the age of eight, the patient had infantile paralysis. There were several other cases in town at the time. A sister, however, sleeping in the same bed with the patient, and the other two children in the family showed no symptoms of the disease. The onset was sudden, and characterized by malaise, headache, vomiting, chill, and fever of 104°. On the third day, when the boy was helped out of bed, his legs gave way and he fell to the floor. Twenty-four hours later the temperature dropped to normal, and the upper and lower extremities were paralyzed. There was no retention and no sensory changes. The child had no pain at the onset, but one week later he complained bitterly of soreness in the legs. A difficult coughing persisted for several months. He was able to crawl and take a few steps by late November, and could walk across the room by December. In March, 1917, he returned to school. He gradually improved so that he could run, play ball, and swim. The mother noted deformity of the back developing immediately after the illness. The scoliosis gradually increased in spite of chiropractic manipulations and the wearing of a spinal brace.

On examination June 10, 1922, severe paralysis of the abdominal muscles, most marked on the right side, was noted. There was isolated weakness in the upper and lower extremities. The scoliosis was to the right in the cervical and dorsal regions and to the left in the lumbar spine. The right shoulder was higher than the left and the right chest wall prominent posteriorly (Fig. 4). There was slight talipes calcaneus and left talipes valgus. The mother believed the deformity was still increasing, and a celluloid body jacket was given for support.

COMMENT

If patients are examined soon after onset the prominent feature is the widespread distribution and severe proportions of the initial paralysis. The muscles whose nerve cells have been damaged, but not destroyed, have not yet resumed their function. New connecting pathways in the nerve tissue have not been established, and the patient has not yet learned to utilize his remaining power to the maximum degree.

As one would expect, the incidence of deformity is greater in cases of long standing than in the more recent ones. This is true not only of untreated cases, but also of those under observation from the onset. Braces, no matter how cleverly constructed, cannot replace the physiologic function of muscle tissue. The relaxation of the paralyzed muscles, the overaction of their antagonists, weight bearing and gravity, all contribute toward the development of deformity.

The treatment of poliomyelitis in the advanced stage is largely surgical. Various standard types of operation have been devised for certain deformities. The results of astragalectomy, arthrodesis of the midtarsal joints, tendon transplantations and other procedures in the foot are well known. Other operations are being developed. Perhaps the most disabling conditions result from paralysis of the spinal and abdominal muscles and the muscles about the hip-joint. These are believed to be most unresponsive to treatment. Hibbs,[1] however, has demonstrated that the progress of paralytic scoliosis may be checked by his fusion operation on the spine. Until recently it was thought that nothing could be done for the limp caused by weakness of the gluteus medius muscle. In January, 1923, Legg[2] described an operation of transplanting the tensor fasciae femoris, for which he claims good results.

CONCLUSIONS

1. Anterior poliomyelitis is an infectious disease characterized by inflammation of the gray substance of the spinal cord, and attended by motor paralysis and deformity. It is of wide distribution and often occurs in epidemics.

2. Experiments have shown that the infecting organism enters the body probably through upper respiratory passages.

3. In the Mayo Clinic series the disease occurred during the first three years of life in forty-four per cent. of the patients.

4. The onset is acute, but the residual state of deformity is permanent, and may progress or become accentuated by the growth of the child.

5. Usually the patient does not seek aid until after the deformity has become well established. The average duration of the paralysis in a series of 350 cases was eight and four-tenths years.

6. The paralysis is most marked in the lower extremities. The anterior tibial muscle was the one most commonly paralyzed.

7. Talipes equinus and talipes valgus were the most common deformities.

8. Scoliosis occurred in 31.4 per cent. of the cases.

9. Marked improvement follows proper treatment given early in the disease. The treatment consists of rest, massage, the application of heat, muscle training, and the use of splints and braces.

10. In many cases surgical treatment of the residual deformity is of great benefit. It aids in correcting deformities, stabilizing the limb, and increasing the function of the limb.

Table 1

Distribution and degree of paralysis, upper extremity

Muscles	Grade 1	2	3	4	Total
	Cases				
Anterior deltoid	70	19	28	19	136
Posterior deltoid	55	12	33	19	119
Serratus magnus	68	14	19	5	106
Triceps	44	19	25	6	94
Lower trapezius	52	17	18	6	93
Pectoralis major	51	17	17	5	90
Biceps	59	12	11	4	86
Latissimus dorsi	44	13	25	3	85
Rhomboids	41	19	13	7	83
Outward rotators	47	18	9	8	82
Supinator brevis	57	4	9	5	75
Pronators	55	6	7	4	72
Interossei	38	13	9	11	71
Opponens pollicis	32	13	14	11	70
Wrist flexors	45	11	8	3	67
Thumb extensors	45	10	5	6	66
Upper trapezius	49	5	8	4	66
Thumb flexors	40	11	7	7	65
Finger flexors	45	7	5	6	63
Finger extensors	42	7	6	6	61
Wrist extensors	42	4	9	4	59
Lumbricales	32	9	8	9	58

Table 2

Distribution and degree of paralysis, lower extremity

Muscles	Grade 1	2	3	4	Total
	Cases				
Anterior tibial	95	41	166	158	460
Posterior tibial	120	35	183	105	443
Gastrocnemius	80	41	254	31	406
Hip abductors	171	73	146	9	399
Ilio psoas	209	57	117	8	391
Quadriceps	151	43	152	32	378
Extensor longus digitorum	117	51	128	81	377
Gluteus maximus	175	53	135	13	376
Peroneals	128	29	122	95	374
Outer hamstrings	171	58	112	27	368
Inner hamstrings	170	53	106	24	353
Flexor longus digitorum	141	52	115	45	353
Hip adductors	126	44	149	29	348
Hip outward rotators	157	45	88	22	312
Flexor proprius hallucis	124	57	78	77	306
Extensor proprius hallucis	117	26	74	80	297
Flexor brevis digitorum	155	23	48	44	270

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ARTHROGRYPOSIS MULTIPLEX CONGENITA

BY PHILIP LEWIN, M.D., F.A.C.S., CHICAGO

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INTRODUCTION. The condition herein described is of sufficient and unusual interest to warrant a description of two cases.

The name used is that coined by Stern.

NOMENCLATURE. Dorland's dictionary states that the word "arthrogryposis" is derived from two Greek words meaning curved joint, and defines it as persistent flexure or contracture of a joint.

FIG. 1
Photograph of Case 1.

LITERATURE. The only article I have been able to find in the literature is that by W. G. Stern of Cleveland in which he describes four cases. In December, 1923, Chatterton demonstrated several cases of this condition to the Clinical Orthopedic Society at Phalen Park, St. Paul.

ETIOLOGY. The etiology of this condition is unknown. The various possibilities are: heredity, infections, circulatory, glandular, or mechanical disturbances occurring during intrauterine life.

There is no history of heredity in the cases reported or in the present series. There is no proof to support the theories of infectious, circulatory, or glandular etiology.

FIG. 2
Roentgenogram of Case 1.

INTRAUTERINE MECHANICAL DISTURBANCE. It is possible that the theory of Mürk Jansen of the causation of achondroplasia might explain this condition: viz., a small amnion with increasing hydrostatic pressure.

Stern believes that this condition is the result of a rare combination of intrauterine periarthritis and intrauterine pressure.

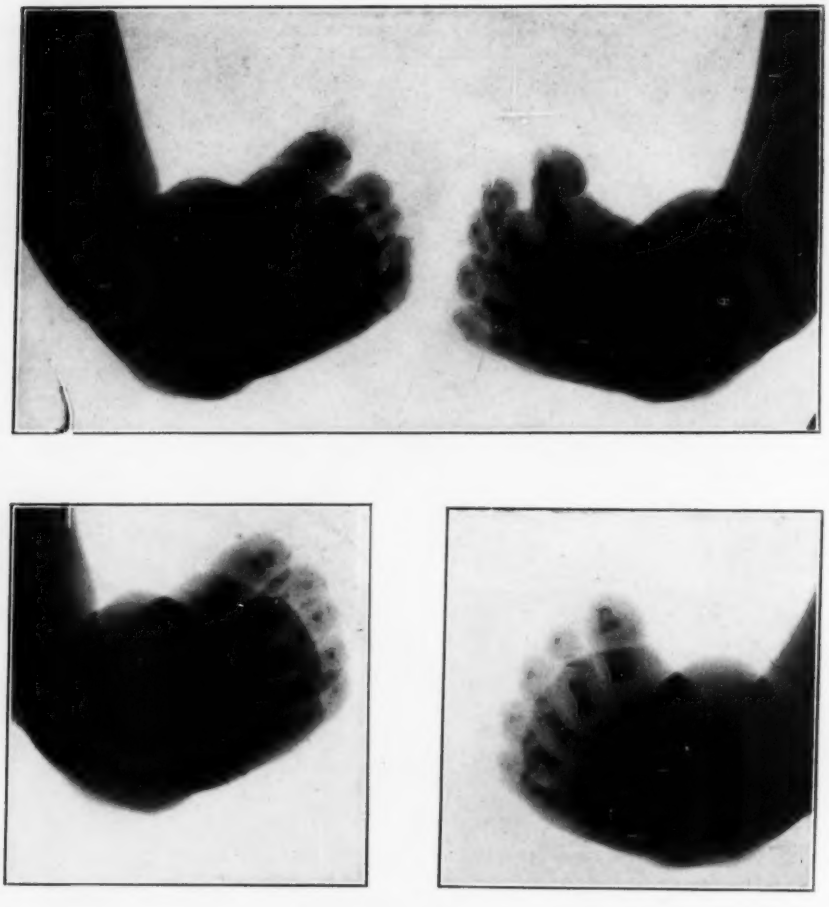

FIG. 3
Roentgenogram of feet of Case 1.

PATHOLOGY. The pathology is confined to the articular and periarticular structures.

There are primary and secondary changes.

SIGNS AND SYMPTOMS. The history reveals a congenital deformity. The physical findings are deformity with limitation of motion. The deformity consists of clubbed hands and feet with limitation of motion of all joints, especially of hands, feet, elbows, knees, shoulders, and hips. In the two cases seen by the author there has been a diamond-shaped

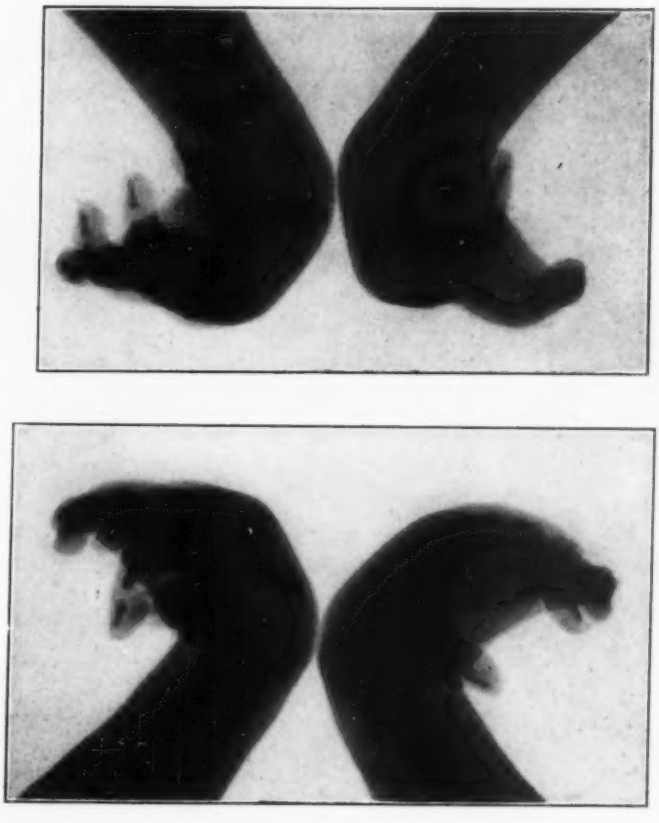

FIG. 4
Roentgenogram of hands of Case 1.

position of the lower extremities. Stern describes rotation of the humeri so that the elbows point forward, and a similar rotation of the femora.

Mentality is much below par.

The roentgenograms reveal the exact condition of the joints.

DIAGNOSIS. The diagnosis is very easy. In the knee it is necessary to rule out congenital genu recurvatum, which is manifested by abnormal mobility in extension with limited flexion and usually transverse creases over the extensor surface of the knee.

PROGNOSIS. The prognosis is very poor.

TREATMENT. The treatment consists of gradual correction of the

deformities. This should be accomplished in several stages because of the danger of impaired circulation.

Attempts to produce movable joints are not highly successful.

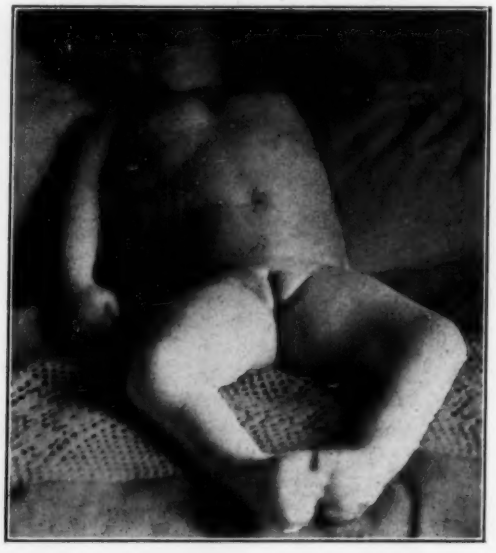

FIG. 5
Photograph of Case 2.

CASE REPORTS

CASE 1. V. B. White boy, aged 6 weeks, admitted to St. Luke's Hospital on the service of Dr. J. L. Porter, March 13, 1922, and died of acute enteritis July 15, 1923.

HISTORY: Complaint: Bowed legs, bowed hands, and undernourishment.

Onset and Course: The baby was born with markedly bowed legs, and the hands are held with the wrists markedly flexed.

Past History: Normal delivery; full term pregnancy; breast fed with supplementary feeding.

Family History: Mother and father living and well; five brothers and one sister, living and well; one brother died of pneumonia at 1 year; no similar condition in family. No history of tuberculosis.

Physical Examination: The baby is a fairly well-nourished but much deformed child. Both hands are flexed at the wrists at right angles. There is ulnar deflection. Both thumbs are held in adduction and flexion. The fingers are like claws, long and tapering, and lying across each other. The arms are held in extension and it is impossible to flex the arm at the elbow, even with considerable force, to as much as a right angle,

FIG. 6
Roentgenogram of Case 2.

nor can the arms be abducted from the body beyond sixty degrees. The child moves its arms slightly, but all movement seems to be from the shoulder.

The child lies with both legs abducted, and externally rotated. There is considerable limitation of movement at the hips and knees. It is impossible to extend the legs at the knee much beyond a right angle. The feet are in a position of marked equino-varus.

The head is round and symmetrical. The sutures are closed and the anterior fontanelle is extremely small, admitting barely the tip of the little finger. The neck is not held rigid. The features are normal except that he has a pug-nose. The eyes are normal, no strabismus or nystagmus. The pupils are equal.

The circumference of the head is 35 cm. (biparietal). The abdomen looks large, and measures 32 cm. at the level of the umbilicus. There is a distinctly flaring costal margin. At the level of the nipples he measures 32 cm.

The heart is not enlarged, the sounds are clear, and there are no murmurs. The lungs are resonant and no râles are heard.

The abdomen is slightly distended and there is a slightly palpable spleen; no other adventitious masses in the abdomen.

The throat is normal.

Treatment and Results: Under ether anesthesia the deformities of the hands and feet were corrected twice, but the casts had to be removed because of circulatory disturbances.

Case 2. M. W. Cornell, Ill. Private patient referred by Dr. R. I. Barrickman of Streator, Ill. White baby; aged 14 months.

History: Child was born with clubbed hands and clubbed feet. No family history of a similar condition.

Physical Examination: Was negative except for the deformities which were as follows:

Typical bilateral extreme talipes equino-varus and club hands.

Legs form a diamond shape.

Recommendations: Slow forcible correction and casts.

SUMMARY AND CONCLUSIONS

Definition. A condition of unknown etiology characterized by congenital deformities and limitation of joint motions. The treatment is very unsatisfactory.

The author desires to express his thanks to Dr. Stern for his paper and personal communications, and to Drs. J. L. Porter and R. I. Barrickman.

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PRIMARY TUMORS OF THE PATELLA

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The literature on primary tumors of the patella is very scant and it has probably been possible, therefore, to find most of the reported cases. These will be briefly summarized and discussed, and another case, a personal observation of the author and of a type apparently hitherto unreported, will be added to the not very lengthy list. So far as possible all growths not of a definite primary character have been omitted from the study, although, of course, under the discussion of the differential diagnosis all lesions which might be confused with such tumors are considered. The reported cases follow:

CASE 1. WILKES. A female, 24 years old, struck her knee two and one-half years before observation. There had been pain since that time and for the past twelve months a swelling of the knee had been present. There was also a small swelling at the base of the metacarpal bone of the first finger. The swelling of the knee was felt as a simple enlargement of the patella with the joint itself unaffected. The general health of the patient was good. In February, 1842, the leg was amputated above the knee, and a tumor mass, confined to the patella, without joint invasion, was found. The patella was 3″ x 2″ in size and seemed to be an expanded bone. The soft interior could be completely removed, leaving a perfect shell behind, but the anterior part was composed of fibers of ligament interspersed with bone. It was practically an osseous cyst filled with tumor mass. A diagnosis of myeloid disease of the patella was made. The patient left the hospital with the stump healed, but no subsequent history is known.

CASE 2. D'ARCY POWER FOR ROBERT JONES. Girl, aged 20 years, fell upon her knee in the summer of 1890. She suffered pain and inconvenience for four or five days after the injury, but recovered completely. She again fell upon the same knee in the spring of 1891, and although the fall was not severe the knee-cap commenced to swell. Robert Jones was consulted in 1892, about twelve months after the second accident. She then seemed to be suffering from a chronic inflammation of the patellar bursa; the skin, however, was blue and brawny and the hollows around the patella were obliterated. Pressure was therefore applied over the patella and the patient was sent away with a back splint on the affected leg. Six weeks later the knee was more swollen, and as the swelling appeared to fluctuate it was aspirated, but only blood withdrawn. The patient would not allow an incision to be made into the tumor and she was accordingly sent home again in a splint, but no further pressure was applied over the joint. This treatment was continued for a period of twelve months, during which the swelling steadily increased in size. The patient's permission to incise the tumor was at last obtained and it was found to be a sarcoma, and the thigh was amputated in its lower third. Specimen:

A longitudinal section through the patella. In the shrunken condition it measured four inches in length by two and one-quarter inches in thickness, and the whole substance of the patella was involved. The bone appeared to have completely disappeared, but the articular cartilage was healthy. The tumor was solid and microscopically consisted of an ordinary myeloid sarcoma. There was no involvement of the other structures entering into the knee joint. This was the only growth from a patella ever shown before the Pathological Society of London. The Hunterian Collection contains an endosteal myeloid sarcoma of the patella, presented by Sir Astley Cooper, but it differs from the

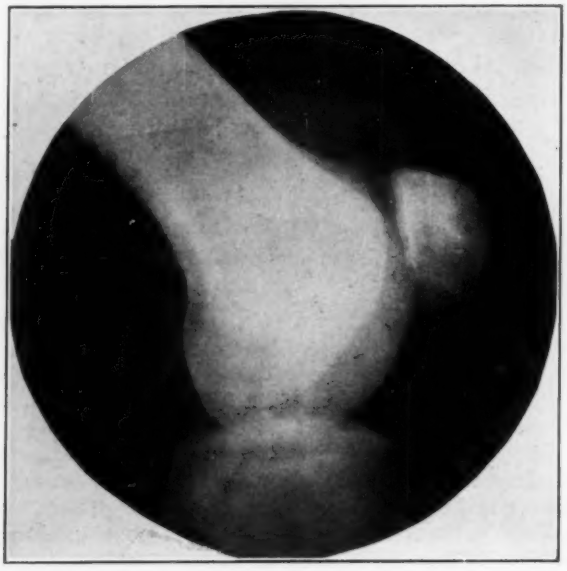

FIG. 1

Roentgenogram taken a few days before the patient was first seen. It shows a rarefaction of the lower half of the patella with apparently an intact bony shell.

above in being cystic. In the discussion following the presentation of this case it was stated that St. Mary's Hospital Museum contained a specimen of primary sarcoma of the patella.

CASE 3. CREITE. Man, 42 years old, was seen after two months of slightly painful swelling of the knee. Aspiration of the knee gave a clear fluid. A diagnosis of tuberculosis was made, the joint was injected with a phenol solution, and a plaster-of-Paris dressing applied. The condition became worse and five weeks later a patellar swelling was noted. This was aspirated and a bloody fluid obtained. Resection was done and the patella found to be the seat of a large spindle cell sarcoma. The man was still apparently cured at the end of seven months.

CASE 4. MORANEK. A man, 30 years old, who had had stabbing pains in the knee for over ten months following a fall upon that knee. A slowly growing tumor appeared which was well circumscribed on roentgenographic examination. The patella was extirpated. Histologically the tumor was diagnosed as a giant-celled sarcoma. The result is reported good.

CASE 5. WANACH. Reports a case of primary sarcoma the size of child's head in

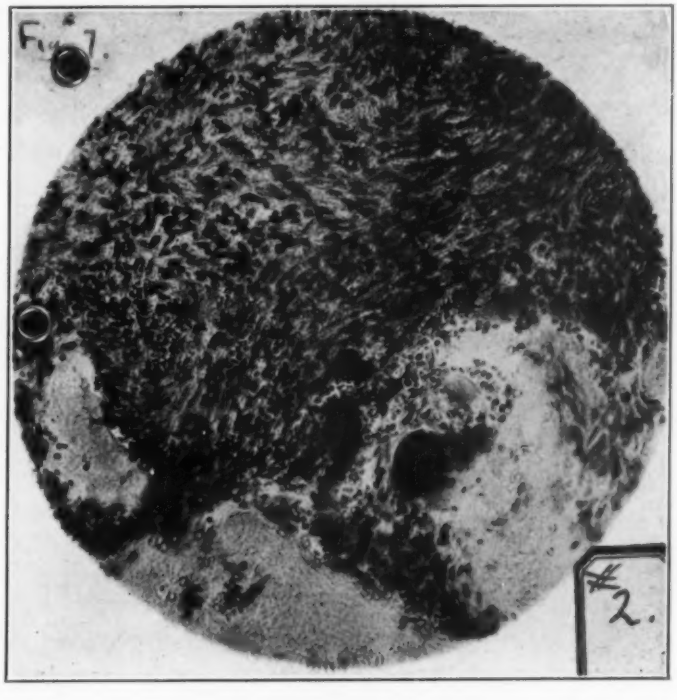

FIG. 2

Photomicrograph of curettings. Shows a very cellular ostitis fibrosa.

which the patella was extirpated and the patient well at the end of four years with no recurrence.

CASE 6. HORAI. Woman, 39 years old, who for four years had worked on her knees as a bamboo washer. Twenty-one months previously there had been pain on the outer side of the left thigh, which was relieved by massage. About ten months previous to observation the patient fell on the left knee and sustained a contusion which resulted in pain and swelling in the joint, but no discoloration. The pain left in a few days, but the swelling persisted. The patient noticed she was falling easily even before the above accident. Four months before seeking treatment the skin over the knee, which had gradually become discolored, ruptured in three places and bloody fluid

escaped. Infection resulted and an increase in the swelling and a discharge of bloody pus followed. Patient went into the hospital and an examination showed a large tumor of the patella. There was 40 cm. enlargement around the base of the tumor, 35 cm. enlargement over the center, and 12 cm. enlargement around the upper end. The left inguinal glands were enlarged. Amputation was performed and the tumor found to be a myeloid sarcoma. The case was still well when reported, but no time was given.

CASE 7. GROSS. Man, 69 years of age. Vague pains in the right knee for several weeks, but no findings except pain on motion, with a slight limitation of motion. A

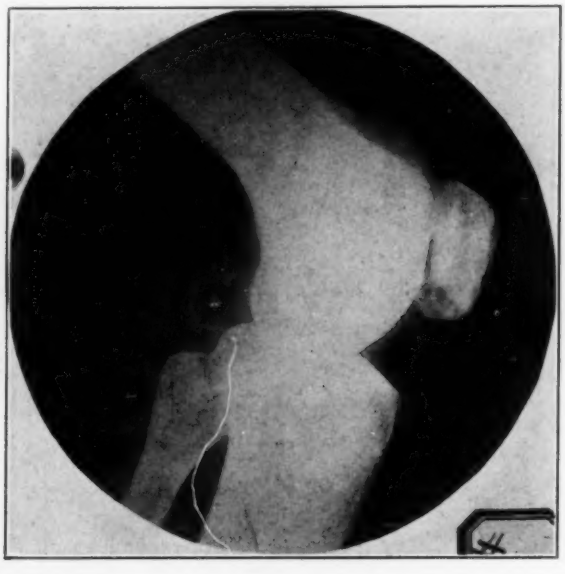

FIG. 3

Roentgenogram taken April 17, 1922. Cavity apparently filling with bone.

diagnosis of rheumatism was made. Later a tumor of the patella developed which was the size of half an orange. This was pulsating and the skin over it became discolored and the overlying vessels dilated. On ausculation a bruit could be heard. The roentgenogram showed the condition limited to the patella. Some four months later the tumor was excised. Infection occurred and six months later amputation was performed and recurrences were found in the lower end of the femur. Later on growths appeared in the right mastoid and the temporal bone and there were clinical signs of pulmonary involvement. Death occurred with signs of cerebral pressure eight months after the amputation. No autopsy was allowed. The pathologic diagnosis was plexiform angio-sarcoma of myelogenous origin.

CASE 8. KUDLECK. Man, 25 years old, who struck his right knee against a stone step one and one-half years previous to observation. There was severe pain at the time, and following it occasional stabbing pain in the knee, although not severe enough to prevent work. One year before, patient fell with a horse, and right knee was caught beneath the animal. From that time on there was continuous pain in the knee, with a stabbing pain on any mis-step. Fourteen days before, a third accident resulted in the knee being struck against the sidewalk. Following this the leg became weaker and the pain so much worse that a doctor was called. Examination showed the region of the

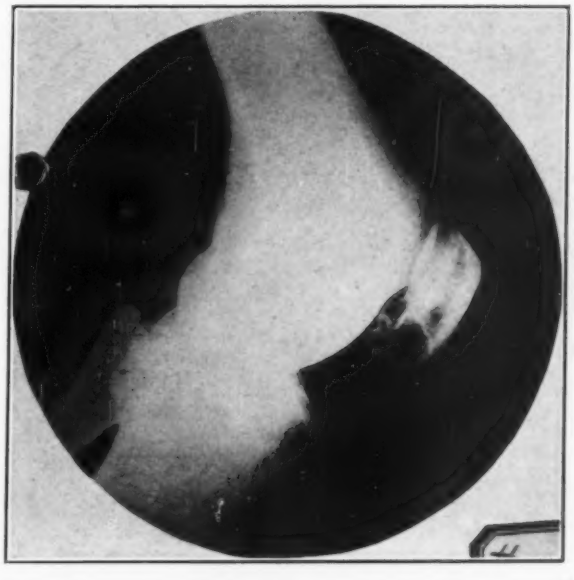

FIG. 4

Roentgenogram taken August 21, 1922. Shows recurrence of cystic condition.

right patella protruding on account of a thickening of the patella itself, and crepitation was felt on pressure over the anterior surface. There was atrophy and weakness of the quadriceps. Complete extension was impossible and flexion was allowed only to ninety degrees. Lymph glands were palpable in both groins. Measurements showed one-half cm. enlargement of the knee over center of patella. The roentgenogram showed refraction of the lower two-thirds of the patella with a distinct thin outline, the same on the anterior and posterior sides. This thin wall was broken through slightly in two places. A diagnosis of central tumor of the patella, either a cyst or a sarcoma, was made. The patella was extirpated and the patient discharged from the hospital in about six weeks. Pathologically the tumor was a central giant-celled sarcoma. (Prof. D. Jores.) The patient was still well and without recurrence after nearly two years.

CASE 9. PELLEGRINI. Reports an exostosis of the posterior surface of the patella pressing into the joint cavity.

CASE 10. KAISER. A patient, 18 years old, who for four years had had pain and a dull feeling of pressure in the left knee, especially on kneeling down. No history of injury. For almost seven months swelling had been present and the joint had been aspirated twice with the withdrawal of clear fluid. Examination showed the left knee swollen, and the patella, which was floating, more than twice normal size. Extension of the knee was not interfered with and flexion was present to eighty degrees. The roentgenogram showed the indefinite shadow of a tumor-mass pushing the patella to

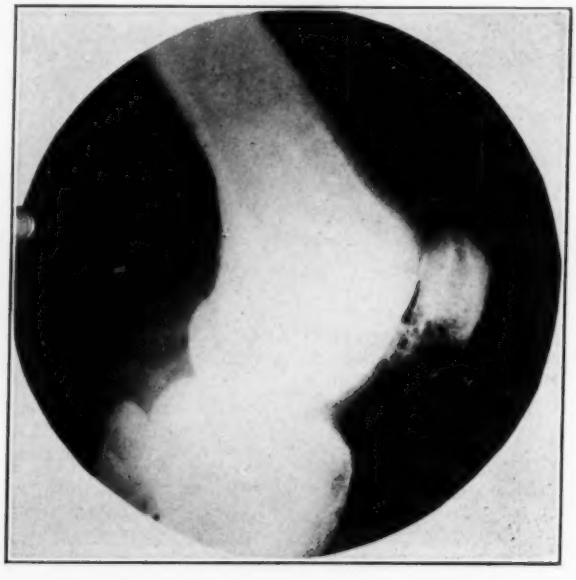

FIG. 5

Roentgenogram taken February 14, 1923. Shows increase in area of cyst.

the outer side and from this a diagnosis of osteochondroma was made. Clinically, a tumor, tuberculosis, or some inflammatory process were the most probable conditions considered. At operation an intra-articular tumor with a bony base attached to the posterior, internal border of the patella was removed. Pathologically this was a cartilaginous exostosis. There was no return after six weeks and the functional result was perfect.

CASE 11. ANZILOTTI. A boy, 10 years old, with a tumor of the patella, which started four to five months after a fall on the knee when six years old. Examination showed fluid in the joint and a marked interference with function. At operation the outer third of the patella was removed, together with the tumor, which was cap-shaped,

but arose from a small base. Pathologically the tumor was an osteochondroma with a lively growth of cells showing under the miscroscope. In this case there was also an exostosis on the external condyle of the femur and a small lump like a sesamoid bone on the synovial membrane of the knee joint. The diagnosis was osteochondroma, probably resulting from embryonic rests.

CASE 12. RAY. A boy, 9 years old, was kicked on the knee three to four months previous to observation, and a growing lump appeared on the upper and outer border of the patella. At operation a nodular cartilaginous mass three and one-half inches in diameter was removed. The boy was still well seven months later.

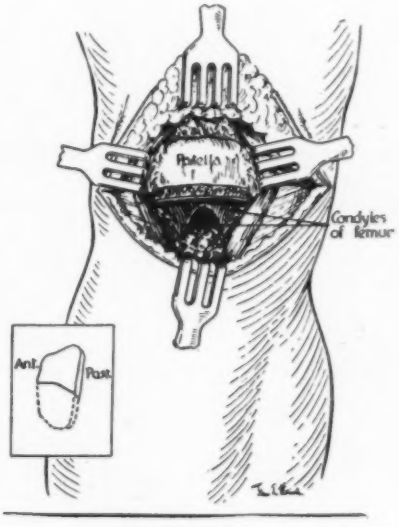

FIG. 6

Shows extent and character of second operation.

CASE 13. SCHWARTZ, J. A boy, 13 years old, who one year previously struck his left knee against a stone. Eight weeks later a slowly growing swelling of the knee was noticed, but there was no pain. Examination showed the left knee swollen and fluctuating. There was normal extension, but no flexion inside a right angle. No pain. Measurements showed two and one-half cm. enlargement at a point five cm. below the joint, five cm. enlargement over the patella and four cm. enlargement above the patella. An antero-posterior roentgenogram was negative. At operation a round tumor the size of a hen's egg was removed with a chisel. It was attached to the outer quadrant of the posterior surface of the patella and had a cauliflower appearance on the joint side. Pathologically the tumor consisted of a white cartilaginous mass with a few scattered foci of glass-like appearance which were soft. Microscopically the tumor was a chondroma.

CASE 14. MICHON AND CHARRIER. Man, 42 years old, was admitted to the hospital on June 20, 1853, for a tumor of the front of the left knee. In 1839 a contusion of the patella resulted in a painful knee, but patient was able to continue work. In 1841 the patella was fractured by a sudden effort of the patient to save himself from falling after slipping. This was treated by a splint and the fragments remained separated from one and one-half to two cm. and the knee remained permanently larger than the

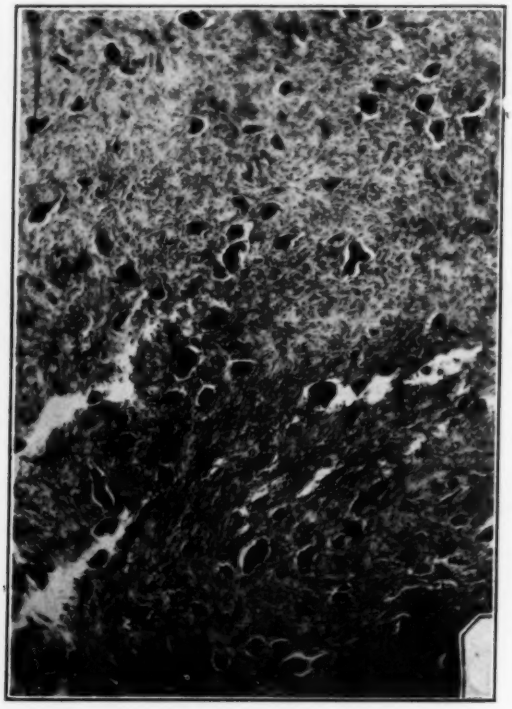

FIG. 7

Photomicrograph of tissue removed at second operation.

other. In 1851, without known cause, the knee became very painful and treatment for tuberculosis of the joint was started. This gave no relief. Examination on admission showed an ovoid tumor of the front of the knee following the axis of the extremity. The tumor was large and prominent and very hard, but fluctuated in three places, over which areas there was heat and redness. It was not attached to the tibia or femur, as it could be moved from side to side. Motion was present in the knee but was very painful. A diagnosis of osteosarcoma was made and the leg amputated. Microscopically the tumor was made up of "cancer cells." The soft areas were filled with what seemed to

be a bloody pus. There were two small tumors back of the tibio-fibular joint of the same structure as the main tumor but the knee joint itself was clear. On August 10, 1853, six to seven weeks later, the patient was still well.

The following cases are listed by Schwartz but it has been impossible to find the original reports and only the second hand data can be given.

CASE 15. LUCKE. A woman, 24 years old, who died of metastasis to the lungs after resection.

CASE 15. HAYEN ET GRAUX. A woman, 22 years old, with a tumor of the patella for over a year. It was a central round-celled sarcoma and the patient died from metastases to the lungs. The metastases were spindle-celled sarcoma.

CASE 17. WILD. A woman, 30 years old, who had injured the knee twice over four years before. The leg was amputated and a peripheral mixed-celled sarcoma was found. One year and seven months later the patient was still well.

CASE 18. PARKER. A girl, 13 years old, with a history of injury over nine months before. The tumor appeared some time after the injury. Extirpation was performed three times, but recurrence occurred in the scar two years and seven months after the first operation and metastasis in the iliac glands appeared six years afterwards. Death occurred in seven years. The tumor was a peripheral spindle-celled sarcoma.

CASE 19. SCHMIDT. A woman, 45 years old, who sustained a fall seven and one-half years before. A tumor had been present for five years. Amputation was performed and a peripheral small spindle-celled sarcoma found. The case is reported as healed.

CASE 20. BALDWIN. Boy, aged 19, had a fracture of the patella two months previous to observation. On account of continuance of pain and enlargement a roentgenogram was taken which demonstrated a marked enlargement of the patella with apparently intact bony shell, the lower two-thirds of the bone being markedly rarefied. Diagnosis of tumor of the patella was made and on March 21, 1922, the bone was excised. The pathological report showed a typical giant cell tumor. There has been no recurrence of the tumor and the function of the knee is almost normal.

In addition to the above cases there are a few more indefinite references to be found in the literature. Schwartz, in his thesis at Paris in 1880, says he found two cases of sarcoma of the patella out of a collection of one hundred and fifty-five bone sarcomata of the lower extremities, but does not mention them further. Nasse merely quotes the statement of Schwartz. Gurlt mentions one fibroma of the patella but gives no particulars. J. Schwartz lists under Gurlt's name a central sarcoma and another under the name of Bocker and counts these as the first two cases in his list of twelve reported sarcomas of the patella. Several cases reported as tumors of the patella are really bursal lesions or growths in the patellar tendon. Such cases are those of Martinez, Stros, and Dallies, and they cannot, of course, be included in this study.

Most of the text books of surgery and surgical diagnosis do not mention new growths of the patella, but de Quervain calls attention to

the fact that among the rare tumors of the anterior surface of the knee-joint should be noted sarcoma of the patella.

An analysis of the cases cited shows that most of the tumors, both benign and malignant, except myxoma and cyst, which have been found elsewhere in bone, have been found in the patella. There is apparently no reason why this should not be so as we have in this bone all the elements, except epiphyseal cartilage, which one finds in the rest of the bony frame work.

The author's case appears to be one of benign bone cyst and is reported as such, although no similar case has been found in the literature.

CASE 21. A female, aged 31 years, was first seen on November 5, 1921. Her history showed that she fell on the left knee in October, 1920, sustaining only a slight injury. There was no trouble for three months, but then pain developed in the knee upon going up or down stairs. There was no discomfort, however, when the knee was at rest or when the patient was walking on the level ground. Since that time the knee has become slightly worse and she cannot kneel upon it or extend it to the straight position without pain. There had been a very definite syphilitic infection some years ago and in May, 1918, very active anti-luetic treatment was started, since which time about twelve salvarsan injections, in addition to several courses of mercury rubs and injections have been given. There have been six negative blood Wassermann tests within a year, the last, ten days ago. Her general health is excellent. Examination shows that apparently the left knee is normal. Palpation, however, reveals slight tenderness over the lower part of the patella and active extension cannot be performed beyond 160°. Passively, this motion is free, however, to hyper-extension. There is a painful catch at one point during this passive motion. The roentgenogram brought in by the patient shows a rarefied, cystic condition of the lower part of the patella. It was decided to observe the case for one month before deciding on treatment.

December 2, 1921. A second roentgenogram shows the condition progressing and operation was advised. Apparently the posterior wall of the tumor has broken down so that the cavity in the patella connects with the knee joint and a small projecting portion is seen at this point. The clinical diagnosis was not definite, but wavered between a benign solid or cystic tumor, with a remote possibility of tuberculosis or syphilis.

January 10, 1922. Operation. Through a vertical incision the anterior surface of the patella was exposed and a piece of its anterior surface one by one and one-half cm. in size was removed. A cavity containing clear fluid was exposed whose walls had the appearance of a granulation tissue. This bled very freely on curetting. The posterior wall of the cavity had broken through into the knee joint as had been suggested by the roentgenogram. It was possible to strip a lining membrane off the fragment of bone removed, but no definite lining was found on other than the anterior surface of the cyst. The cavity was thoroughly curetted and packed with iddoform gauze to control bleeding.

The packing was removed two days later and the wound healed within a few days.

Pathology. Cultures and animal inoculation made from the curettings were negative. The gross specimens were very small and resembled blood clots except for the rectangular fragment of bone. From the inner side of this fragment could be stripped a definite membrane. Microscopically the tissue was a very cellular ostitis fibrosa with some giant cells and many mitotic figures.

Diagnosis. Ostitis fibrosa; benign bone cyst. This tissue was examined by Dr. Bloodgood, whose report is quoted: "The section shows blood clot and the usual picture of ostitis fibrosa, which is very cellular. Also much pigment in the cellular areas and some giant cells. I feel it is not malignant. . . . .

Diagnosis. Bone tumors—Ostitis fibrosa—Cyst–Patella."

March 6, 1922. The function of the knee is almost normal and the roentgenogram shows the cavity filling in with new bone. The small projection into the joint is still present.

FIG. 8

Roentgenogram taken July 8, 1924. No recurrence.

April 17, 1922. The range of motion is free except in extreme of flexion. Roentgenogram shows the healing process apparently progressing, but there is a questionable rarefaction appearing near the lower end of the patella and in the projecting portion.

August 21, 1922. Slight tenderness over lower edge of patella. Motions normal. The roentgenogram shows, however, what appears to be a recurrence of the cyst with definite proliferation of bone on under-surface of patella, extending into the joint cavity.

November 15, 1922. Patient still complains of tenderness over the patella and states that motion in the knee is not quite so free. Examination shows very definite tenderness over the lower half of the patella and a questionable thickening here. Active hyper-

extension of the knee is not possible and passively this motion is painful. Roentgenogram shows the definite recurrence of the cystic condition.

January 5, 1923. Not much change in condition of patient. She is able to work as a seamstress, but cannot take long walks or actively use the knee without discomfort or pain. X-ray examination shows little change.

February 14, 1923. Symptoms, examination and X-ray examination practically the same.

March 13, 1923. Second operation. Under tourniquet a curved incision was made running around the front of the left knee just below the patella. The tendon on and below the patella was split longitudinally and freed from the bone. The distal half of the patella was then resected by means of a chisel and rongeur. The part removed was cystic but contained no fluid and the cavity was lined with a greyish granulation-tissue-like substance which extended into the joint. There seemed to be no infiltration of this probable tumor tissue and a definite line of demarcation separated it from the infra-patellar pad where the two came into contact with each other. The raw bone surface of the remaining portion of the patella was cauterized with pure carbolic followed by alcohol. Longitudinal slits were then made in the capsule of the joint on either side and the cavity formed by the removal of the lower half of the patella partially obliterated by drawing the two halves of the split tendon together. Heavy chromic cat-gut was used for this purpose. After closure of the superficial wound a rather bulky dressing was applied to partially immobilize the knee, but no splint was used.

Healing was uneventful and in two weeks the patient was walking around with crutches and some weight bearing. A roentgenogram taken March 21, 1923, eight days after the operation, showed the amount of patella remaining. Sections of the tissue removed at the operation showed the same very cellular ostitis fibrosa as was present at the first operation, with numerous giant cells. There is no doubt that a certain amount of this tumor tissue was left behind at the first operation probably in the portion projecting into the joint, and thus recurrence was invited. On account of the breaking through into the joint, which was recognized before any treatment was given, it is felt now that resection rather than curettement should have been done in the first place.

May 28, 1923. Practically free motion in the knee. Patient states she has no pain at any time. Roentgenogram shows no recurrence, but some proliferation which is rounding off the lower surface.

October 17, 1923. Patient states she can use knee as well as ever. No tenderness or limitation of motion. Roentgenogram same as last.

December 8, 1923. Patient reports knee is apparently normal.

January 16, 1925. Patient reports knee as good as ever.

Although traumatic conditions of the patella are common, inflammatory conditions are met with much less often, and new growths, as we have seen, are exceedingly rare. Osteomyelitis, especially that of tuberculous origin, is the most common of nontraumatic conditions, and Koenig reports 33 cases out of a series of 281 patellar lesions. Non-tuberculous osteomyelitis is not so common, but has occurred at all ages, the majority of reported cases, however, being in children over six years and under fifteen years of age. The symptoms of the acute forms are those of osteomyelitis elsewhere and need no elaboration here, but the tuberculous

type may easily simulate benign bone cyst and must be kept in mind in making a diagnosis of a chronic patellar lesion.

Apparently only one case of syphilis of the patella has ever found its way into the literature, although the condition must be more common than that would lead us to believe. It was one of the suspected conditions in the case forming the basis of this paper, but was later ruled out.

Parasitic cysts or lesions of the patella, so far as can be found out, have never been reported.

FIG. 9

Reproduction of illustration of case reported by D'Arcy Power for Robert Jones.

Shows the clinical enlargement of the patella, the seat of a giant cell tumor.

Secondary involvement of the patella with tumor growth may occur in sarcoma involving other structures of the knee joint, and both Schmidt and Schwartz (J) mention carcinomatous metastases from a primary growth in the prostate.

Of the primary tumors around the patella, arising from the various fasciae and the aponeuroses, fibromata and lipomata are the most common. They, with the various bursal enlargements, must be borne in mind when making a differential diagnosis. Gurlt's reported case of fibroma of the patella, mentioned above, must have belonged to this class.

Having definitely narrowed down a diagnosis, so far as possible, to that of a patellar tumor by exclusion of inflammatory conditions and lesions of surrounding tissues, a further differentiation must be made and a basis of treatment decided on. Malignant conditions of bone usually give a fairly definite clinical picture, but the prognosis is so poor in all true central and periosteal sarcomata that, as Bloodgood states, no radical operation should be performed until every possible means of diagnosis has been employed. "The burden of proof is to demonstrate that the lesion is malignant."

The presence of a rapidly growing tumor with severe pain and later involvement of the overlying structures and skin and clinical destruction of bone, gives a picture which is definite, especially if the radiographic examination shows the characteristic bone destruction and proliferation. It must be remembered, however, that in the early stage a central sarcoma can not be differentiated always from a benign lesion by the X-ray.

Bloodgood's study of 240 cases of bone tumor shows that with a central tumor of bone the probabilities that it is benign are as 107 to thirty-one. The benign cyst is the most common before fifteen years of age, only a very few giant-cell tumors being found up to this time. After twenty years the cysts are very rare and between twenty and thirty years the giant-cell tumor is the predominant growth. It is extremely difficult at times to differentiate clinically or by the roentgenogram between central bone lesions due to a bone cyst, a giant-cell tumor, a myxoma, a chondroma, tuberculosis—or even an early central sarcoma. Where the roentgenogram shows a bony cavity with preservation of the bony shell and no enlargement or periosteal proliferation the diagnosis is sometimes impossible. Later, if such periosteal proliferation does occur, the malignancy of the growth probably is assured, but if swelling or enlargement develops without the proliferation, both tuberculosis and sarcoma can be ruled out. The line of demarcation between the cavity and the surrounding bone is very definite in all the benign tumors, as distinguished from the malignant growths and tuberculosis, and the mottlings or striations running across the tumor shadow are more marked in the giant-cell tumors and chondromata than in cysts. Perforation of the bony shell has occurred in giant-cell tumors, as in the case of Kudleck, in benign cysts, and in benign chrondromata, so it cannot be looked upon as a definite sign of malignancy as has been frequently stated, although it is, of course, far more common in the latter types.

Clinically, pain is not a common symptom of a benign cyst, unless a fracture has taken place, but it is always present in giant-cell tumors and

only rarely absent in the other benign and in the malignant growths. Pathologic fracture is by far the most common symptom of onset in bone cysts.

Bloodgood states that "if the duration of symptoms is more than two years the probabilities are that the lesion is a cyst or a giant-cell tumor." Examination of the histories of the cases of tumor of the patella outlined above shows that this principle is also true in our series, the malignant cases seeking surgical advice much sooner than the benign ones. In the author's case, the age, thirty years at the time the symptoms were first noticed, was against the diagnosis of benign cyst, but the absence of

FIG. 10

Gross specimen of same tumor.

pain except on pressure was in its favor. Malignancy could apparently be ruled out for the same reason, and the lack of knee joint symptoms, even with the apparent break in the posterior wall of the patella, seemed to exclude tuberculosis.

Where the diagnosis is not clear or absolutely certain, exploratory incision must be used as the final aid, and probably the majority of cases of bone tumor will need this. One should be ready, however, to proceed with the indicated treatment immediately the gross appearance or the frozen section has pointed it out. This latter is not absolutely necessary, however, as experience has shown that the danger of dissemination of

malignant cells by the exploring knife is minimized if the wound is properly cauterized.

Periosteal growths of the malignant types have been found in the patella as we have seen, and their course was undoubtedly the same as with such tumors in the other bones of the body, that is, death in practically 100% of the cases. Unfortunately the subsequent histories are not all clear enough to allow a definite statement to this effect. The same is also

FIG. 11

Reproduction of published roentgenogram of Kudleck's case of giant celled tumor. Even this poor picture shows a striking resemblance to the roentgenogram of the author's case.

true of the central sarcomata, although here we could expect, reasoning from analogy, a rare cure. The histories show that the giant-cell and other benign tumors were all cured up to the time of reporting and we can feel sure that they remained so from the study of such tumors in general.

The treatment of tumors of the patella must follow the principles now generally laid down for bone tumors elsewhere. Malignant growths should be removed locally if this can be done with certainty, and it would seem

that this is more possible with the patella than with any other bone in the body. Even then, of course, the prognosis will be very bad, as death is practically always due to internal metastases, principally to the lungs, and not to local recurrence. These metastases apparently are disseminated very early and are frequently present by the time the primary growth is noticed. Giant-cell tumors can be cured by curettement and local recurrence prevented by cauterization of the cavity thus formed with pure carbolic acid followed by alcohol. Benign cysts of bone have healed spontaneously, there being four cases on record, three of Bloodgood's and one of Colvin's. Where this diagnosis is fairly certain and the case can be followed by the X-ray there is no apparent danger in allowing treatment to be delayed if the danger of pathologic fracture can be obviated. Where the condition is progressing, either clinically or by the X-ray, the cavity must be opened and the lining membrane removed or the masses of ostitis fibrosa curetted away. No one has as yet reported a case of myxoma of the patella, but if one does occur it should be treated with the greatest care and precaution to prevent dissemination of the myxomatous cells, which are apparently extremely malignant if once set free. The wound, after removal of such a tumor, should be cauterized with carbolic acid, followed by alcohol and then packed for a short time with gauze wet with 50% zinc chloride solution.

CONCLUSIONS

1. Tumors of the patella are very rare, only nineteen definite cases having been reported in the literature. To these might be added the first two in Schwartz's list of twelve cases, no other mention of which could be found, the two specimens mentioned in the discussion of D'Arcy Power's case, and Baldwin's unreported case, making a total of twenty-four. The author's case makes the twenty-fifth and is the first benign cyst of the patella recorded.

2. All the common tumors of bone have been found in the patella except myxoma.

3. The course, the treatment, and the prognosis of patellar tumors are the same as for similar growths in the rest of the bony framework.

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THE GENERALIZED TYPE OF OSTEITIS FIBROSA CYSTICA

VON RECKLINGHAUSEN'S DISEASE

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The term "von Recklinghausen's Disease" is frequently applied to localized cystic conditions in bones which show one or more areas of decalcification with fibrous replacement.

Bloodgood,[1] Barrie,[2] Silver,[3] Meyerding,[4] Elmslie,[5] and others have added much to the literature of this subject.

Although both Meyerding and Elmslie discuss the generalized type of this condition in their papers, it would seem proper that the term "von Recklinghausen's disease" be reserved, in accordance with his own description, to those cases in which the disease is diffuse and slowly progressive.

In 1891 von Recklinghausen,[6] made his first report, describing three cases of generalized bone involvement, and applied to this condition the name "Osteitis Fibrosa Cystica," which he considered descriptive of the bone lesion. In 1910, he[7] made further contributions and reviewed the literature to that date.

As early as 1886, Hirschberg[8] described the same condition, but he did not recognize it as a clinical entity, but considered it a form of osteomalacia.

Since that time, although the literature contains many instances of the localized form, reports of the generalized type are exceedingly few.

The excellent review of this subject by Morton[9] states that "Ringel, in 1918, asserted that there are about thirty cases known, and Roth, in 1920, that there are only forty."

It seemed to me, therefore, worth while to add to this sparse literature a case that has come under my observation.

CASE REPORT

Mr. I. S. Age 51 years, banker, had the usual infectious diseases of childhood, but remembers no illness since that time. During early adolescence he played base ball and foot ball and romped about as much as other boys but never sustained any injury to his bones.

At about the age of 22 years, he fell and fractured the left humerus. This healed normally and has not troubled him since that time.

In 1914, at the age of 41 years, while skating, he fell and sustained an injury to his left hip. Immediately following this injury he was able to walk and to attend to his affairs, though with much pain. For one year he was treated by a physician, who gave

FIG. 1
Comminuted Fracture of Right Humerus.

electric treatment to his hip. Towards the end of that year he noticed his left leg growing shorter, and his physician advised a lift attached to the sole of the left shoe.

About one and a half years after the injury he went to an orthopaedic surgeon, who applied a plaster cast to the hip and told him that he had an infectious arthritis, and that he would get well.

In 1916, while wearing the cast, he was pushed and fell, sustaining a fracture of the

tibia and fibula of the left side. A plaster cast was then applied to the entire limb and necessitated his remaining in bed for a number of weeks.

In December, 1923, while going down stairs, he slipped, and in the effort to save himself from falling, injured his right shoulder. It was at this time that I first saw him.

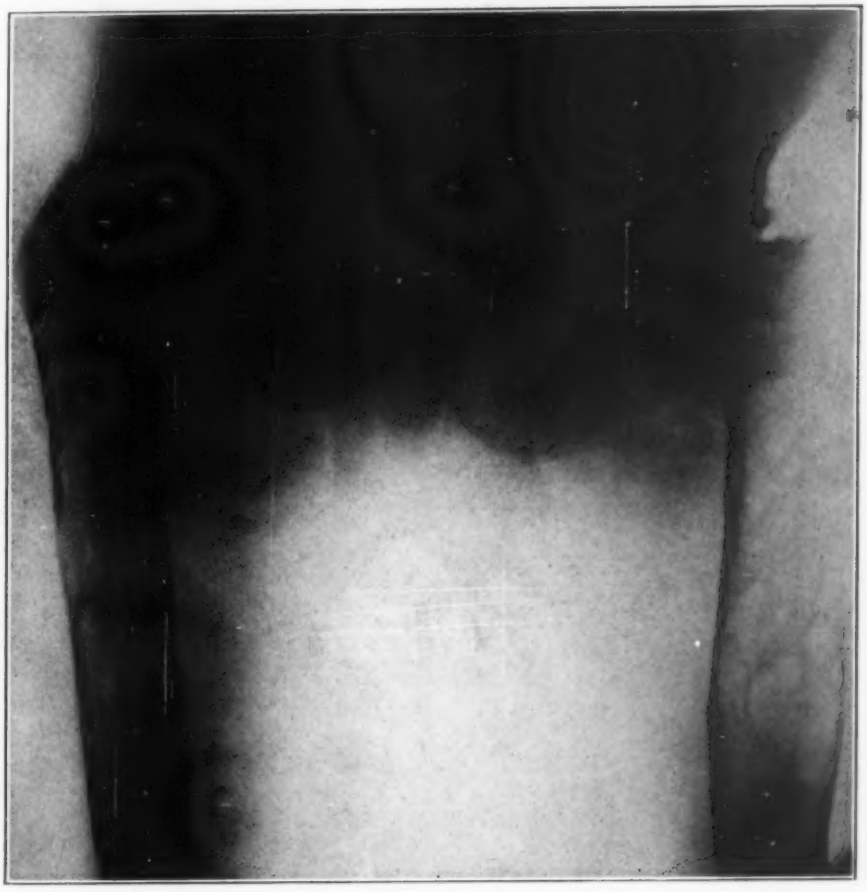

FIG. 2

Old fracture left hip, showing cystic condition of femora and pelvis not involved in the process.

PHYSICAL EXAMINATION. Tall, slender man, sallow complexion, sclerotics white, chest and abdomen normal, no enlarged lymphatics. Walks with a stiff left hip and angular deformity of the left leg below the knee. The left hip is firmly ankylosed. Flexion and extension is accomplished by motion of the pelvis. There is no rotation.

Motion at the knee joint is perfect, but at about two inches below the knee there is an angular deformity of about 10 degrees, throwing the foot and leg outwards. This latter

FIG. 3

Old healed fracture of Tibia and Fibula.

FIG 4.

Right Femur, showing extensive cystic involvement.

deformity, together with his ankylosed hip, apparently gives him greater stability than he would otherwise have.

The right shoulder is markedly swollen and painful. There is crepitus upon passive motion.

The roentgenogram showed a comminuted fracture at the anatomical neck. The

blood shows a secondary anemia. The urine is normal. There are no Bence-Jones bodies in the urine.

A plaster cast was applied. The cast was removed at an early date and motion begun. The healing seemed to occur unusually rapidly and after two months complete function was restored.

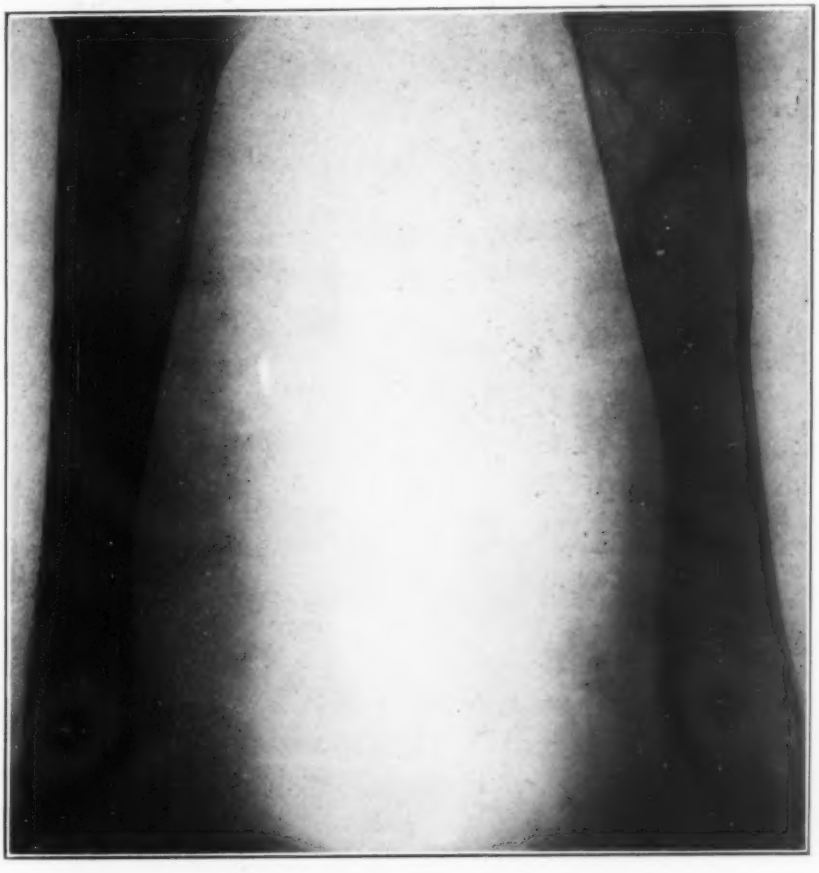

FIG. 5
Right and Left Femora.

The history of the case suggested some underlying pathologic bone condition, and the roentgenogram of the shoulder corroborated that idea.

Roentgenograms were made of all his long bones and skull. The roentgenograms show the typical generalized type of osteitis fibrosa cystica or von Recklinghausen's disease.

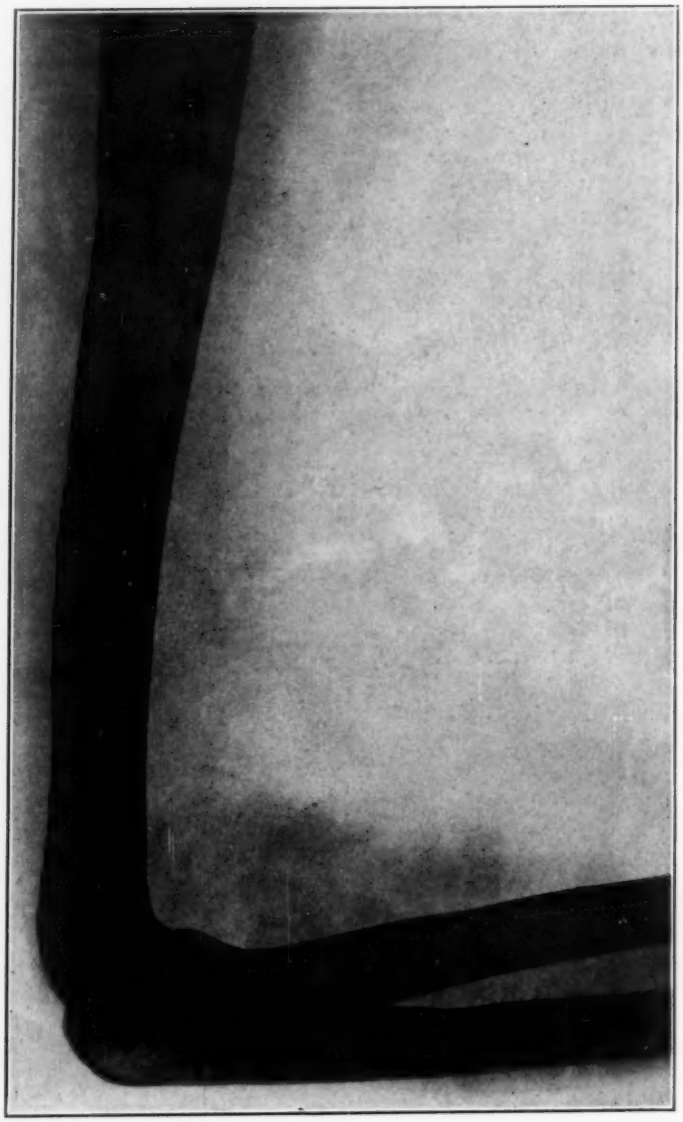

FIG. 6
Left Humerus.

Morton has attempted to classify the cases thus far reported and I have tried to fit my case into one of his classifications. He first divides the cases into two groups:

FIG. 7
Right Humerus.

Group 1. Without giant cell sarcoma.

Group 2. With giant cell sarcoma.

My case shows no evidence of giant cell tumor and would, therefore, fall under Group 1.

Morton then divides Group 1 into three classes:

a. With multiple cysts, fibrosis, and malacia, confined to a few bones.

b. With multiple cysts, fibrosis and predominant general malacia.

c. With multiple cysts, fibrosis, general malacia and hyperostosis.

FIG. 8

Right and Left Radius and Ulna.

In the case described herewith, which is almost devoid of malacia, though practically all of the long bones are involved, it would most resemble cases classed as Group 1*a*.

The roentgenograms of this case demonstrate the characteristic fibrosis with cyst formation of the medulla, and thinning out of the cortex of all of the long bones.

There is practically no malacia in this case. The softening process varies in all cases, but I have seen no case reported in which there is so little malacia. Perhaps this fact is due to the sedentary and sheltered habits of the individual.

If it is fair to presume that the disease was present at the time of his

FIG. 9
Skull.

first fracture, at the age of 22 years, the present state represents a duration of 30 years. While all of the reported cases have been slow in progress, they would suggest an advance somewhat greater than this case.

A feature of this disease is the rapid healing after fracture, and would indicate that the osteogenic function of the cortical bone is not interfered with, and that the disease resides in the marrow and endosteum.

Although the pathology of this disease is different from that of osteopsathyrosis, osteomalacia, and Paget's disease, that fact does not necessarily preclude them from the same or similar etiology.

These diseases all share in varying degrees decalcification, fibrosis, and osteogenesis, which represent disfunction of the bone-forming organism. The widespread occurrence in all the long bones would strongly suggest a central controlling mechanism. Disfunction of the pituitary and parathyroid bodies probably represent factors in the etiology of this group of diseases, but the extent of their rôle is still entirely undetermined.

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DISPLACEMENT OF THE SEMILUNAR CARPAL BONE

An Analysis of Twelve Cases

BY JOHN D. ADAMS, M.D., F.A.C.S., BOSTON, MASS.

Statistics supplied from broader fields of activity tend to stimulate us to a careful analysis of our own personal experience in any one type of injury. Over a period of one year there passed through the Industrial Accident Board of Massachusetts 5,062 injuries to the wrist. Of this number nineteen cases were diagnosed as uncomplicated dislocations of the semilunar bone of the wrist. It is natural to conclude that of this number all had impaired function. Otherwise they would not have been brought before the Board for consideration. Lack of proper filing facilities makes it impossible to collect these cases to ascertain the history or end-result. Therefore this fact is of interest solely in giving us a percentage on which to base the incidence of occurrence of this injury.

It is the writer's opinion, taken from his own actual experience and that of others, that the displacement of the semilunar carpal bone occurs more often than it is actually recognized. Three cases of this series were treated for strain. In all cases roentgenograms were taken and displacements unrecognized.

Stimson, in his very excellent work on fractures and dislocations, states that "the X-rays have shown that dislocation of the semilunar bone, either alone or in combination with fracture of the scaphoid, is far from uncommon and is second in frequency to fractures of scaphoid." He further states: "Of each of these there are many clear uncomplicated cases. Most of the injuries to the wrist are to the lower end of the radius. X-rays following injuries in this region should be carefully examined as to the presence of fractures, also to relationship of the carpal bones to each other and to radius and ulna."

Ross and Stewart, in 1911, tabulated observations of 145 cases, 25 involving the wrist. Of this number seven proved to be fractures of the scaphoid, one of os magnum, one of the lower end of radius, scaphoid, and semilunar in same wrist. "There was not one of semilunar alone."

Cohn, in an excellent article, reports one case and discusses at length

the relative frequency of this injury. He states "that during the past ten years at the Surgical Clinic at Touro Infirmary we have seen only one uncomplicated case of the dislocated semilunar carpal bone."

Foss and Cranmer reported three cases of dislocated semilunar bone. They touched upon the mechanics of the injury and the various forms of treatment.

This analysis is based upon a collection of twelve cases, covering a period of two years. Six of these cases were treated personally and the other six were contributed by Dr. George W. Bachman.

This analysis may be classified under five headings: (1) mechanics of the displacement; (2) classification of the various types; (3) various forms of treatment; (4) end-results; (5) conclusions.

In a careful analysis of the roentgenogram one is impressed with the variation in the mechanics as to the degree of malposition of the semilunar and its relationship to the radius and carpus. The question immediately arises as to whether we are dealing with a real dislocation of the semilunar or a relative dorsal dislocation of the carpus.

ANATOMY

The semilunar, in common with all other carpal bones, presents six surfaces. It articulates with five bones, namely: the radius, scaphoid, cuneiform, os magnum, and unciform. The three bones, namely, scaphoid, semilunar and cuneiform, as well as serving as a meniscus, perform the function of a condyle to fit into the concave surface of the radius and intra-articular fibro-cartilage, making a true wrist joint, cotyloid in character. The ligaments are anterior and posterior and two lateral. Here it would seem that strength is sacrificed to obtain the necessary flexibility for such a wide range of motion. The anterior ligament is broad and stronger than the posterior. Its fibres, however, are extremely short, being attached to the lower end of the radius and, running downward and inward, are attached to the surfaces of the scaphoid, semilunar, and cuneiform.

The semilunar on dissection presents a very small area of the anterior horn for the attachment of its ligament, although it will be found in the majority of cases that the fibres extend on to the surface of the os magnum.

The posterior ligament is weaker by comparison, and it is attached in much the same manner. It is this ligament, as will be shown, which is the weak link in the chain of defense.

The lateral ligaments do not concern us in this problem. There are

also short interosseous ligaments on either side of the semilunar connecting with the scaphoid and cuneiform respectively.

Constructively, then, we have three elements: (1) radius and ulna with the fibro cartilage; (2) a meniscus; (3) four carpal bones (trapezium, trapezoid, os magnum, and unciform) supported on the metacarpal bones,—all of which go to form the true wrist joint and the so-called "mid carpal joint."

The hand is capable of the following motions on the carpus and radius: palmar and dorsi flexion, abduction, adduction, and circumduction. All motions but rotation are permitted in the true wrist joint. The articular surface on the dorsal aspect of the carpus extends further back than on the palmar surface, so this admits of greater dorsi flexion. The flexibility of the wrist is maintained in this movement by the rotation of the carpus on the transverse axis drawn through the center of the meniscus between the styloid process of the ulna and radius. There is also a certain amount of lateral sliding motion distributed between the individual bones themselves.

The mechanics of adduction and abduction take place through the distribution of motion in the carpus round an axis drawn antero-posterior through the center of the wrist joint. In the mid carpal joint there is a fair amount of flexion and extension and a very small amount of rotation. A lateral gliding motion between the carpal bones accounts for the flexion and extension, whereas the rotation is in the almost true ball and socket joint of the head of the os magnum in the cavity formed by semilunar and scaphoid on its own axis.

The semilunar, therefore, plays an extremely important part in the mechanical function of all the movements in the wrist. Its position is more or less the keystone in both diameters, and, therefore, is the stabilizing factor in its mechanics.

A constant factor appears in the history of every case in the series, namely, that the force producing the injury has been applied with the hand in forced dorsiflexion. The displacement of the semilunar has always been anteriorly.

Figure 1, representing a normal hand, illustrates the position of the semilunar at the time the thrust is applied. It would seem that we are concerned with a problem in physics: (a) The power is applied on either side of the fulcrum by a quick thrust down the arm and the opposing force against the hand. (b) The fulcrum is the lower end of the radius, and (c) the lever is from the center of the opposing force in the hand to the fulcrum.

We base the following reasoning upon the fact that in all of the open

operations where the semilunar is removed, the anterior ligament is found intact, i. e., unruptured.

FIG. 1
Normal hand. Note the rotation of the semilunar on the radial surface due to the leverage of the head of the os magnum on the dorsal horn.

FIG. 2
Normal hand in flexion.

Referring to Figure 1, we will note that in the position of extreme dorsiflexion the same relative position between the lower end of the radius and the semilunar is still maintained, except for slight rotation

anterior to the joint. We do find, however, that the dorsal horn of the semilunar has ridden forward on the articular surface of the os magnum. This, with the anterior ligament intact, presents an unbroken lever extending from the lower end of the radius across the anterior ligament into the palm of the hand to the opposing force.

At this moment the increased thrust of the back kick of an automobile crank brings the entire strain upon the weak posterior ligament, which is torn, allowing the posterior horn to push the head of the os magnum backward and slide by. Upon the degree of force and the length of time the hand remains in contact with the opposing force depends the degree of displacement.

Figure 2, representing the normal hand in flexion, with Figure 1, illustrates the instability of this bone.

CLASSIFICATION

In classifying the degrees of malposition following injury, one must consider the relationship of the semilunar (1) to the radius, (2) to the os magnum, (3) to the row of carpal bones below it (trapezium, trapezoid,

FIG. 3

Class B. Extra articular displacement. Note normal relationship with both radius and os magnum disturbed. Also a backward displacement of the mid carpal row in its relationship to radius and ulna.

FIG. 4

Class A. type. Semilunar os magnum displacement. Relationship to the radius is maintained.

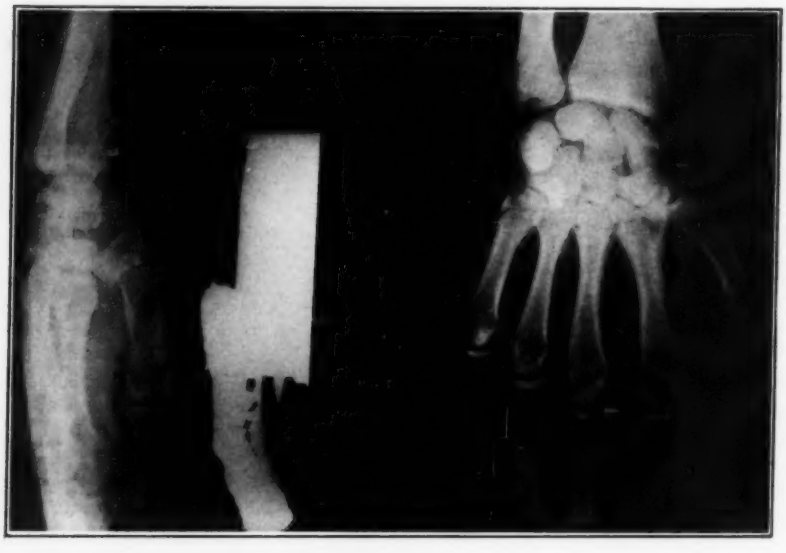

FIG. 5

Class C. Persistent posterior mid carpal displacement limiting dorsi and palmar flexion to ten degrees.

unciform, and os magnum); (4) relationship of trapezium, trapezoid, unciform, and os magnum to the radius and ulna.

The classification might appear as follows:

Class A.—Os magnum semilunar displacement.

Class B.—Extra articular, or radial os magnum complete displacement of the semilunar. (This type the only true dislocation.)

Class C.—Mid carpal dislocation (posterior).

Figure 3 represents Class B type, — extra articular, or complete dislocation of the semilunar in its relationship to the radius and os magnum.

Figure 4 represents Class A type. The semilunar rotates a little posterior but remains in relationship to the articular surface of the radius, but becomes displaced with the head of the os magnum. It will also be noticed that we have in this picture a partial dorsal dislocation of the mid carpal bones: viz., the relationship to the radius and ulna varies distinctly from the normal.

Figure 5 represents Class C type, and shows the semilunar in place following open operation, with a persisting dorsal dislocation of the mid carpus.

TREATMENT

All treatment must be based solely upon the idea of end function. In the majority of these cases we are dealing with bread winners in industry. The only basis on which we can classify our results is on the ability of the individual to do the work he performed prior to his injury.

Treatment falls under four headings:—(1) closed reduction; (2) open reduction; (3) removal of the semilunar; (4) untreated, or "leave it alone."

The writer will not attempt to give a detailed history of all the cases, but will select one case of each type to illustrate the point in question, and at the end of the paper will summarize the results as to the type of treatment.

CLOSED REDUCTION

This should be attempted only in that type of case which falls into the hands of the operator forty-eight hours after injury. This statement is based upon the observation of two or three cases where in the roentgenogram a sclerosed condition of the semilunar is seen, comparable to the osteitis often described in carpal bones associated with injury. In two

of these cases a history of previous injury to the wrist was suspected. It is the writer's belief that in the cases where closed reduction is attempted after the period of forty-eight hours following injury, the danger of producing this condition has to be considered.

Method of Operation. Under an anesthetic, grasp the hand. With strong traction and countertraction the hand is dorsiflexed to the fullest possible extent. Counter-pressure is then placed in the palmar surface of the wrist over the displaced bone, which usually can be readily felt.

FIG. 6

Case I. Closed Reduction. Perfect result. Back to normal work in three weeks. Note the normal relationship of mid carpal row to radius and ulna.

This pressure should be applied with the fingers only and not against a hard surface, as there is great danger of traumatizing the flexor tendons, and producing a true synovitis, which prolongs convalescence. With these forces applied, the hand is then forcibly flexed on the wrist. The operator here may verify his result by gently flexing and extending the hand to the normal range. The hand is then placed on a cock-up splint and radiograms are taken as a record of result. Motion is begun in forty-eight hours. Splints may safely be omitted in one week or ten days. If there is no reaction the patient may safely return to work in one month from the time of injury.

CASE 1 — Figure 6.

History — Nature of Accident. This man was a truckman, driving and cranking a heavy truck, lifting and placing heavy cases on and off a truck. On March 21, 1922, he fell sharply backward and landed on his wrist and hand, bending the wrist backward.

Examination. Showed a young healthy adult with pain and swelling in the wrist joint. Swelling was located over the anterior aspect of wrist and any attempt at motion was painful. He could not actively move his wrist. This case was seen within a half an hour after the injury.

X-ray Examination. Showed Class B type. The radial articular aspect of the semilunar was in contact with the lower articular portion of the radius. The upper crescentic lip of the semilunar lay just below the anterior surface of the os magnum and apparently had displaced posteriorly the os magnum in its relation to the normal axial line of the radius.

End Result. Returned to work in three weeks. Motions absolutely full and free in all directions, with a normally strong grip.

The writer lays particular stress upon the non-use of a broomstick, or any very resisting surface for counter pressure over the flexor tendon. This will be illustrated graphically in a later case. Murphy reports one case in which he lays particular stress upon this fact.

The arbitrary period of forty-eight hours is placed purely upon the basis of the writer's attempt to reduce a semilunar one week after injury by this method. In attempting the possibility of replacing this bone, this is offset with the positive danger of traumatizing the tissue, which either prolongs materially the convalescence or leaves a percentage of impairment in function.

OPEN REDUCTION

This method, with a report of four cases described by Davis, is recommended in the group of cases which comes to the operator some time, a question of weeks or months, after the injury.

CASE II. Figures 7, 8 and 9 represent the case before and after injury and the end-result.

History. This man, W. F., a farmer, while cranking an automobile, received a back kick, injuring the right wrist. The wrist was treated by his physician as a sprain, although a radiograph was taken. The writer saw this case some three months after injury. (It will be noted that the picture shows a border line case between Class A and Class B.)

Treatment — Open Reduction. It was thought advisable to attempt open reduction. The operation was performed according to the method of Davis with the instrument which he recommends. A dorsal incision about three inches long was made and the bed of the semilunar exposed. Here it was found that the head of the os magnum had dropped down, filling up about one-half of the space between the os magnum and the radius. With considerable difficulty the head of the os magnum was forced forward, the instrument engaged the posterior horn of the semilunar, which was rotated back until it engaged the space posterior to the head of the os magnum. Then with counter pressure over the flexor side, the bone was forced back into position. (It is with some

difficulty that this is done in the writer's experience as the os magnum does not go back to its former position without considerable force.) The wound was closed in the usual manner. Hand placed on cock-up splint.

After Care. At the end of three days motion was begun passively once a day. There was considerable reaction in the wrist joint, more swelling than should be expected. The patient ran a very slight temperature. The wound looked clean. The swelling persisted for two or three days and the wrist was extremely painful. A culture was made from the wound and found to be sterile. Motion was stopped after the fourth day. The patient was discharged from the hospital at the end of two weeks with the wound healed, but still with considerable infiltration about the wrist joint, especially

FIG. 7

over the flexor tendons. Baking and massage were begun and carried out faithfully for a period of several months.

End Result. The patient, in January, 1925, sixteen months after operation, showed the result in Figure 7. At the present time the patient saws wood and does chores about the house. Any motions that involve flexion or extension of the wrist are painful. Examination shows no swelling or infiltration of the tissue. The wrist is normal in size. Grip is normal. Adduction and abduction are normal. Palmar flexion fifteen degrees; dorsiflexion ten degrees. The man is unable to do his original work of milking cows.

In analyzing the end result we find what has been the experience of the writer in open reduction, namely, traumatic arthritis. In the cases in this group it has been impossible to engage the semilunar with any

instrument without traumatizing the articular surfaces. At the same time, counter pressure over the flexor tendons produces a subsequent synovitis, which persists. And in this particular case, it has not cleared up in a period of fifteen months.

In Figure 8, the persistent posterior displacement of the mid carpal row may be noted. It is the writer's contention that if this displacement persists, disability and impaired function to the extent of limiting palmar and dorsiflexion is permanent. Although the writer has twice attempted

FIG. 8

After reduction by open operation. Note the persistent dorsal displacement, Class C type, which still persists.

to correct this displacement under ether, he has been unsuccessful. It would seem proof that the only treatment for relieving a permanent disability due to this Class C type would be excision of the carpal row.

REMOVAL OF THE SEMILUNAR

CASE III — Figure 3. Before operation.

History. This man, in October, 1923, was struck by a large girder, rendering him unconscious. He sustained a compound fracture of the ulna, compound fracture of the nasal bones, a fracture-dislocation of the head of the radius, and a complete displace-

ment of the semilunar. Although shown in the roentgenogram at the time of injury, it was not discovered in the interest of treating his other injuries, so that it was three months after his injury before treatment of the semilunar was begun. It might be said in defence of the writer that the man was in a condition of shock, which would not have permitted operation on this wrist for a period of three to four weeks.

Treatment: Removal. An incision two inches long just to the ulnar side and parallel to the tendon of the palmaris longus. (Care must be taken not to open the tendon sheath.) The anterior portion of the anular ligament exposed may be retracted toward the hand, or if necessary, may be divided for a distance of one half an inch. At this point the median nerve should be located. It usually lies just to the ulnar side and

FIG. 9

End result fifteen months after reduction. Note the traumatic arthritis. Dorsi and palmar flexion only five degrees.

beneath the palmaris tendon. This is retracted gently to the radial side. The tendon sheaths of the flexor sublimis digitorum are next retracted to the ulnar side. At this point one can readily feel the displaced semilunar through the deep tendons. By a careful dissection between the tendon sheaths of the flexor profundus one readily exposes the bone. The anterior ligament is always found intact attached to the anterior horn. This is readily severed with scissors, and the bone shells out easily. The tissues fall together readily. If the anular ligament has been cut it should be stitched, as well as the fascia and skin. The hand is put on a cock-up splint; passive motion is begun at the end of forty-eight hours; active motion in four days.

The splint was omitted in one week at which time patient left the hospital.

End Result. Examination, January, 1925: Patient stated that he had some discomfort through the wrist joint, extending across between the ulna and the middle of the

joint. Figure 11 shows the end result. There was full palmar flexion and dorsiflexion; all motions of the wrist were perfectly free. There was no grating apparently and no discomfort on simple passive motion.

The pain that this man complained of was unquestionably due to his mental attitude towards return to work as a stumbling block. This is considered a perfect result by the writer.

In commenting upon this case, it might be said that the writer feels that the rest maintained during the treatment of his other conditions,

FIG. 10

Case III after operation. Dorsiflexion even greater than normal wrist on the right.

combined with extension in a Murray splint, tended to prevent the traumatization of tissues, which occurs in the long neglected cases. Hence, the excellent result in a type of case where operation is prolonged long after the injury.

In analyzing the group of which this case is representative, the constant disability that the writer has found is that with the hand in full hyper-extension resting with the weight of the body on the floor, the patient complains of a weakness in the wrist. This can readily be explained by Figure 11, which shows the downward displacement of the head of the os magnum into the space occupied by the semilunar. This interferes

with the lateral stability of the joint by disturbing the mechanics of the mid carpal row. Also, there is a lateral mobility of the meniscus due to the disappearance of the semilunar.

UNTREATED, OR "LEAVE ALONE" TYPE

Unfortunately the writer has not been able to trace the one case in his experience which represents this condition. It occurs when the semilunar maintains its relationship to the articular surface of the radius but rotates sufficiently to engage the posterior horn of the os magnum to a point just prior to the dislocation of the head of that bone with the semilunar. In this one case this condition existed, and had persisted for a

FIG. 11

Case III. Palmar flexion after operation compared with normal wrist on the left.

period of some months. The patient refused treatment, as he had about fifteen degrees of palmar and dorsiflexion and was able to perform his work without discomfort.

CASE IV.

History. L., December, 1924, fell from an ice wagon, striking his hand in full hyper-extension. Roentgenogram taken at the time, when a diagnosis of dislocation of the os magnum was made. Patient was seen in consultation ten days after injury by surgeon who did not advise operation, on the basis of the patient's unwillingness to submit to operation, and also the fact that the man had a palmar and dorsiflexion of fifteen degrees.

Patient was seen by the writer January 23, 1925, ten weeks after injury. *Symptoms:* Patient complained of pain in the right wrist if any motion were attempted, especially

acute on attempted palmar flexion. No pain if the hand were at rest. Examination of the right wrist showed some infiltration through the soft tissues. There was a slight resistance in the palmar surface of the wrist. No abnormality felt; no surface temperature; no acute points of tenderness. Dorsiflexion, five degrees; palmar flexion, five degrees; abduction, normal; adduction, none; grip, fair.

FIG. 12

Class A. type. Note the complete displacement with the head of the os magnum, which is forced posteriorly, and the force transmitted has caused posterior dislocation of the mid carpal row.

In analyzing the roentgenogram (Fig. 12) we find the semilunar in its normal relationship to the articular surface of the radius but rotated to the extent that the posterior horn has passed across the articular surface of the head of the os magnum, producing a complete displacement of the head of that bone with the semilunar,—Class A type.

This picture illustrates very beautifully the mechanics when we get a dorsal displacement of the mid carpal row, such as exists in this picture. This is caused by the mechanical leverage produced by the os magnum against that row when its head passes posteriorly through the posterior horn of the semilunar.

End Result. The patient has not worked since his injury. The writer has recommended a removal of the semilunar and an attempt to replace to normal position in its long diameter the os magnum.

With the long interim between injury and treatment, it may be necessary to do a resection of part of the mid carpal row to relieve the mechanical impairment of function which, in the writer's opinion, it will produce in this case.

End Result. The twelve cases are illustrated in the following headings:

Open Reduction	2
Closed Reduction	1
Untreated, or "leave alone" type	1
Removal	8

Open Reduction. Both of these cases show permanent disability in the impairment of function in dorsi and palmar flexion. Both are limited to ten degrees in each direction. All motions of the wrist, if forced, are painful. Neither of these men has returned to his former occupation, but they are doing light work. They are looked upon by the writer as possessing a permanent impairment in function in the wrist joint.

Closed Reduction. This one case in this series shows a perfect result. The man has full motion in all directions, no subjective symptoms, and is working at his former occupation. In considering this type, as already stated, the writer tried closed reduction on two other cases of this series and failed.

No treatment, or "leave alone" type. End result: no subjective symptoms; fifteen degrees flexion and extension. The man was doing his former work when last heard from.

Removal. Five of these cases show about three-quarters flexion and extension, and are back doing their former work. The only complaint is a weakness in the wrist when the hand is in hyper-extension. Three are working, but at lighter work than they had previously done, not being able to do their former work on account of some pain and impairment of flexion and extension. This group shows about fifteen degrees of flexion and extension.

CONCLUSIONS

(1) This injury occurs far more often than is recognized.

(2) Stereoscopic pictures should be taken of all wrist injuries.

(3) A true dislocation of the semilunar carpal bone occurs only when it becomes extra articular, namely, when its relationship with both the os magnum and radius has been completely disturbed.

(4) The term "displacement" may be applied to any degree of change from its normal position.

(5) The persistent dorsal displacement of the mid carpal row produces a permanent disability in the wrist. In the early instances it may be restored to normal position, but if allowed to remain is extremely difficult, if not impossible, to cure.

(6) Closed reduction should be attempted only within forty-eight hours of the injury, and then with extreme caution as to traumatizing the flexor tendons and the articular surface of the carpal bone.

(7) Open reduction is attended with a great deal of danger of traumatizing the articular surface of the flexor tendons. The convalescence is long and the end results unsatisfactory.

(8) Removal of the bone should be done in all cases where dorsi and palmar flexion are limited to the extent of interfering with the patient's work. Early motion following operation should be emphasized.

(9) In Class A cases, where the interim between injury and operation does not permit of the closed reduction method and where the rotation on the radial articulation is not sufficient to cause displacement of the articulation with the os magnum, thus leaving a sufficient function in flexion and extension, the operator should carefully consider non-treatment.

(10) All end results should be based upon the ability of the individual to do his original work.

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FRACTURES OF THE CARPAL NAVICULAR BONE

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APPLIED ANATOMY OF THE CARPAL NAVICULAR BONE

In the wrist the navicular is the bone of contention. It dominates the proximal row and is the most mobile of the carpal bones, having a definite range of motion in radial and ulnar flexion and in flexion and extension of the hand and wrist. These movements carry it in ulnar hand flexion well out of its protected socket beneath the lower radial articular surface. Radial flexion brings it securely back into a relatively safer position away from exposure to fracture trauma. When to these lateral movements are added angular changes of the bone in flexion and extension of the hand, which modify the axial relation of the navicular bone to the long axis of the forearm, we may understand why this bone is the frequent seat of the various fractures which afflict it.

RANGE OF MOVEMENTS OF THE NAVICULAR BONE

The surgeon can establish for himself the extent of these variations of position of this bone by holding his own wrist before the fluoroscope. The tiltings in the long axis are not so easy to discern: one must study lateral skiagrams taken with the hand in full extension, neutral position, and flexion to identify the outlines of the three important carpal bones—os capitatum, os lunatum, and os naviculare. For a full, illustrated description of these movements the reader is referred to the author's monograph on the subject of carpal injuries. (Traumatic Injuries of the Carpus. D. Appleton & Co., New York, 1925.)

The movements of radial and ulnar flexion of the hand and wrist cause such a range of excursion of the navicular bone that it appears to become affiliated with both the proximal carpal row—to which it belongs in a position of normal repose of the hand,—and with the distal row, which it tries to join in ulnar flexion of the wrist.

MECHANISM OF NAVICULAR FRACTURE

We say consequently the navicular is the bone of contention, because in falls on the hand, generally outstretched with palmar surface down,

most of the violence received on striking the floor or other surface is transmitted through the longest (middle) metacarpal. This violence proceeds via the os capitatum, at its base, through the navicular, on into the radius. The ulna practically never receives indirect violence from wrist transmission.

FIG. 1

Transverse compression fracture of the carpal navicular taken 1 hour after the accident. This man fell 4 feet down from a step ladder and landed on the palm of his left hand. The very prominent tubercle of the navicular is thrown into profile by the slight rotation of the wrist.

Most of the wrist motions of flexion and extension are likewise confined to the radio-carpal and mid-carpal joints. They are made possible by the mobility and tilting of the bones of the proximal carpal row. In falls on the hand, when the body weight is transmitted via the arm and forearm to the hand and floor, the wrist is usually forced upward into maximal extension, while at the same time it is subjected to crushing violence.

Frequently this trauma ends in a display of force which acts mostly on the lower end of the radius, which is pulled away from the rest of the shaft of the bone, resulting in what we know as a Colles' fracture. However, the position of the navicular at the instant of impact, especially if the hand is in ulnar flexion, may subject it to bending force which exceeds

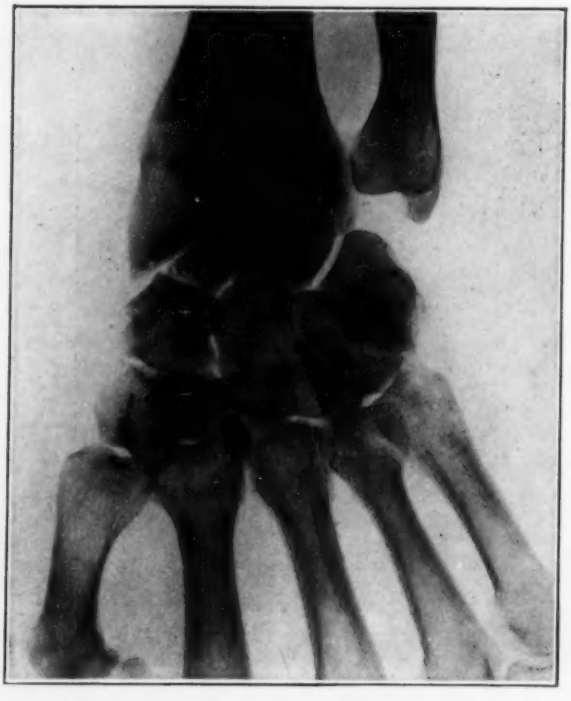

FIG. 2

Compression fracture of the carpal navicular 4 weeks old. The plane of fracture across the body of the bone is quite wide. The distal portion is somewhat comminuted. This bone was removed with relief of all symptoms. In 8 weeks the patient returned to his occupation of chauffeur with less than 10% disability.

its limits of elasticity and accommodation, so that it is split across, and the strain ends by navicular fracture as the trauma ceases. This bone may break and the surrounding ligaments may still carry sufficient force to the radius to cause fracture of the radius also. I need not complicate the picture by saying that in addition to fracture the proximal portion of

the navicular may be dislocated toward the volar surface of the hand, either alone or with its close companion in these hardships—the os lunatum. The navicular fragment is rarely displaced toward the dorsum of the wrist.

TYPES OF NAVICULAR FRACTURE

We find then fracture of the navicular almost straight across its long axis induced by this violence. Direct violence has practically never

FIG. 3

Six weeks old fracture dislocation of the carpal navicular and lunate. It is quite evident that the proximal fragment of the navicular along with the lunate lie on a different plane from the remaining carpal bones inasmuch as their shadows overlap the capitate and the roentgenogram has been made in the exact antero-posterior axis. The proximal navicular fragment and the lunate retain their original bone density as of the time of accident when their blood supply was interfered with. Most of the other carpal bones have undergone some atrophy of disuse and lost calcium salts, as is plainly seen in their lighter shadow. See Figure 7 for similar pathology.

caused such a fracture. A second type of navicular fracture may be caused by a crushing force against the bone when the wrist is in radial flexion

tucked under the protection of the lower end of the radius. In this position the compression may comminute or mash the bone and cause its death by interfering with its blood supply. The result is a reduction of

FIG. 4*

B. Recent flexion fracture of the carpal navicular. This shows the separation of fragments with tilting of the proximal fragment but no dislocation as seen in the lateral roentgenogram.

A. Shows a comminuted vertical fracture of the lower end of the radius. The probable mechanical sequence causing this injury was forced hyperflexion of the carpus resulting in fracture of the navicular by flexion, followed immediately by a heavy fall on the hyper-extending palm with resulting radial fracture. The intense vibration of this heavy fall led to the many planes of fracture in the radius.

the navicular to a foreign body mass in the carpus—a condition meant by the term "Preiser's disease." All these secondary changes follow because its precarious blood supply has been cut off by the trauma.

A third type of fracture of this bone involves the tuberosity alone. By means of a combination of extreme ulnar flexion of the wrist and

* Figures Nos. 4 to 11, inclusive, are taken from the author's monograph, entitled "Traumatic Injuries of the Carpus," D. Appleton & Company, 1925, by their permission.

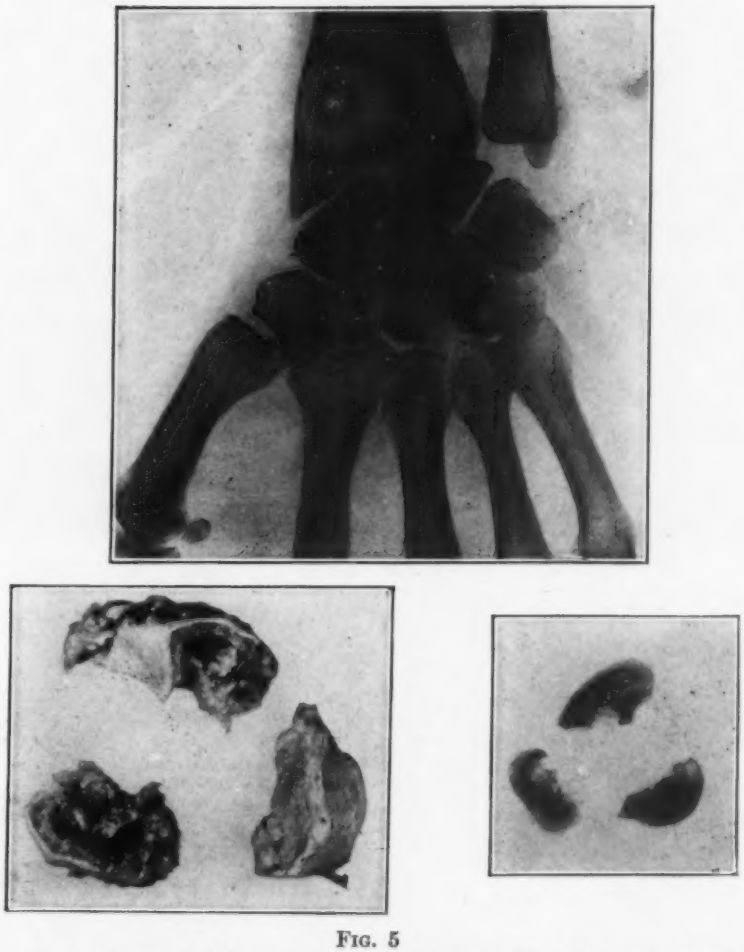

FIG. 5

Flexion fracture of the carpal navicular 5 years old. The upper arrow points the old plane of fracture, still unhealed. In the distal fragment of the bone can be seen a light area of bone absorption and yet the whole bone *after 5 years* retains a greater X-ray density than the surrounding bones.

Below is a photograph of the removed fragments of the navicular. All the cancellous center of the bone has been absorbed. Fibrous tissue alone fills the cavity. At the right side below is a roentgenogram of the three removed fragments. This bone was dead except around the periphery and would never be more than a foreign body in the carpus.

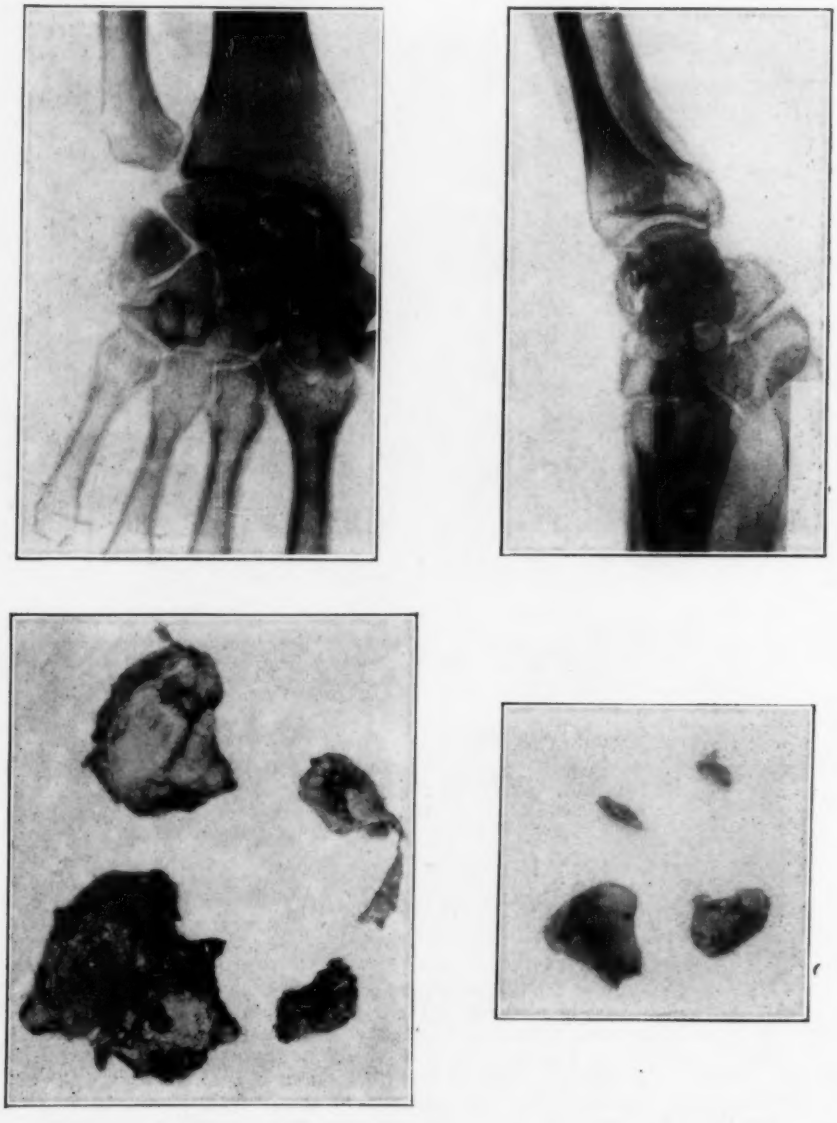

FIG. 6

A five-year-old comminuted navicular fracture. In the antero-posterior view, upper left, is seen the great density of the fractured navicular. The lateral view upper right fails to show any carpal dislocation. At the lower left are seen the removed navicular fragments, softened, dead and filled with fibrous replacement of the cancellous bone. At the lower right is a roentgenogram of these fragments.

FIG. 7

A. Lateral view of fracture of the navicular with the proximal navicular fragment along with the lunate retaining a normal relationship with the radius. The rest of the hand and carpus including the distal navicular fragment have been dislocated dorsally—transnavicular perilunar dorsal dislocation of the wrist.

B. Antero-posterior view showing the fractured and dense navicular along with the lunate and the overlapping shadows of dislocation.

Below, the wrist after carpalectomy of the entire navicular and lunate—the remaining carpal bones settle down next to the radius; the carpus shortens and an excellent functional result follows.

indirect crushing violence of a fall on the hand, the ligaments inserted into the tuberosity may pull out that portion of the bone away from the rest of its body.

OCCURRENCE OF NAVICULAR FRACTURE

The first two types of fracture are quite frequent; they occur about once in ten times as often as Colles' fracture and may accompany it as

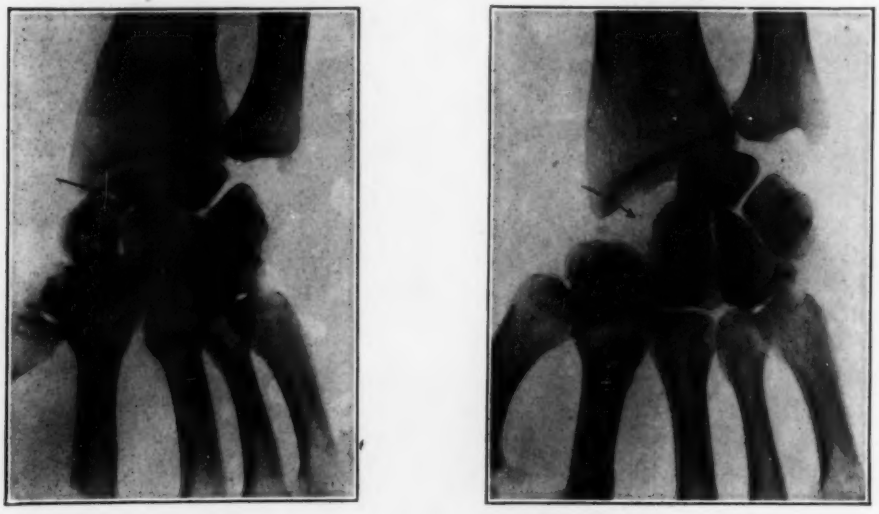

FIG. 8

Recent comminuted fracture of the navicular seen at the right. Note that all carpal bones have the same X-ray density. The situation was explained to the patient; he elected removal of the navicular rather than to accept 8 weeks immobilization with no positive assurance of bony union after that time.

At the left is seen the roentgenogram of the carpus after the navicular was removed. The patient returned to work (steamfitting) 8 weeks after the accident.

stated. The third type, fracture of the tuberosity, is very rare, and may be dismissed by saying that it always unites by bone to the remainder of the navicular, causes no other symptoms than those of a sprained wrist, and requires no splinting or immobilization in its treatment.

PATHOLOGY OF NAVICULAR FRACTURE

The two major types of fracture of the navicular undergo a regular pathologic progress. When the trauma acts it splits the navicular or crushes it and cuts off the fine vessels which supply the cancellous bone

forming the main mass of the navicular. The outer cortex is thin and is in large part covered with cartilage on account of the many articulating facets of the bone. The blood supply to the center arrives from minute

FIG. 9

Recent fracture of the carpal navicular with volar dislocation of the proximal fragment; it looks in both antero-posterior and lateral view like the lunate, but it is not, inasmuch as the lunate can be seen in normal position.

Below at left, the removed proximal navicular fragment, at right, roentgenogram of it. Being very recent, little change is noted. The whole bone was removed, which procedure is undoubtedly the best where such extensive fragment dislocation has taken place, even when the fracture is recent.

end-branches of the radial artery. There is no true nutrient artery, but the vessels spread out in the periosteum and ligamentous attachments. If this supply is shut off the bone immediately becomes anemic, and if the

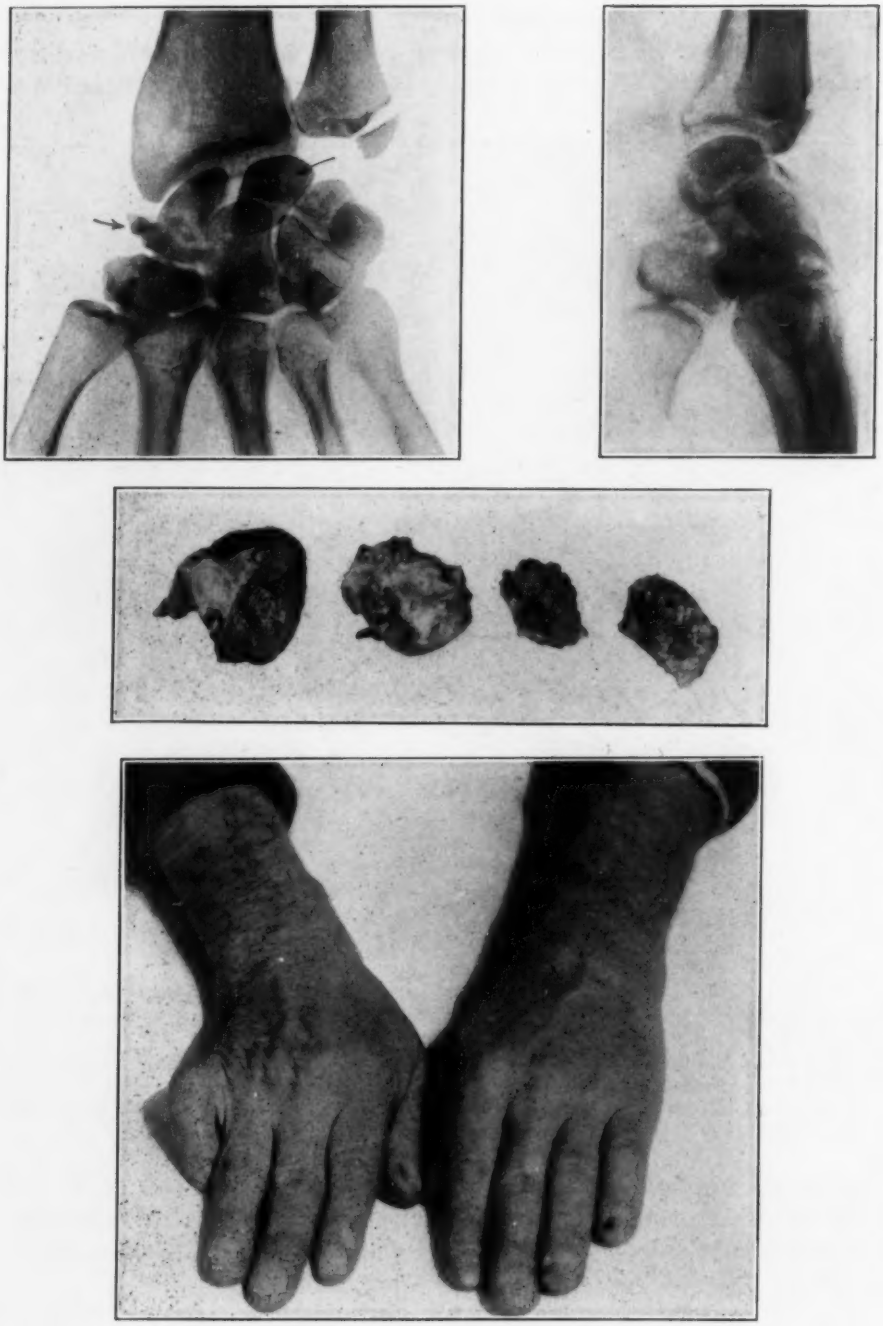

FIG. 10

Antero-posterior and lateral roentgenograms of old compression navicular fracture along with dislocation (volar) of the lunate. In the center are the fragments of navicular and lunate removed. Below is a photograph of the two wrists six weeks after operation. Which one was injured?

fracture is not recognized, if use, massage, and forced motions are practised on the wrist, the blood supply cannot re-establish itself. The inside of the bone dies.*

ACTION OF THE SYNOVIAL FLUID

Formerly it was believed that the action of the synovial fluid then became a factor and led to an absorption of the center of the bone. Radio-

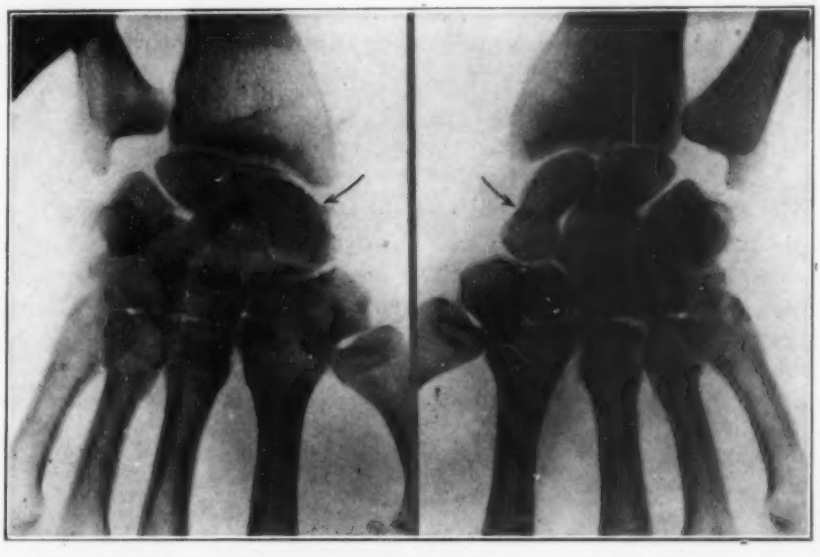

FIG. 11

At the right is one wrist of a young man. The navicular has evidently arisen from two centers of ossification, which have ultimately fused. To this I apply the term wasp-waisted navicular.

His other wrist (at the left) contains a bipartite navicular; the arrow points to the articular plane between the true navicular (distal portion) and the metanavicular (proximal portion).

The metanavicular (proximal portion) has been fractured. Operation was refused because the patient was a chiropractor, but spinal adjustments failed to give relief from pain or to lessen disability.

graphic observation after such fracture shows that as months pass the plane of fracture widens and becomes more apparent. Lighter spots of lessened density resulting from bone absorption begin after a year or two to appear in the skiagram. My study of these bone changes seems to show that the

*Fate of the Fractured Carpal Navicular. Speed: Trans. Amer. Surg. Assoc. XLII — 244, 1924.

belief in the destructive action of the synovial fluid on the bone is a false premise—that *the action of the synovial fluid is really beneficial* and preserves alive layers of superficial cartilage and bone cells to which it has ready access.

DELAYED PATHOLOGY AFTER NAVICULAR FRACTURE

The process of slowly extending osseous death, bone absorption, and fibrous replacement goes on, year after year. Eventually the dead navicular leads to irritation in the surrounding bones and after five to ten years we may find much new bone formation thrown out from the radius and carpal bones which will lead to a bony ankylosis of the radio-carpal and mid-carpal joints.

SYMPTOMS OF NAVICULAR FRACTURE

The symptoms of navicular fracture are easily demonstrated. There is restricted and painful wrist motion, especially extension of the wrist. The hand grip is weakened. There is tenderness when the dorsum of the wrist is pressed over the bone and *pressure in the tabatière unfailingly yields exquisite pain in fresh fracture.* The radial side of the wrist becomes slightly swollen, ecchymoses are rare, but the outlines of the tabatière rapidly disappear, to return after ten or twelve days. By drawing the hand into radial flexion with the fingers flexed, a smart tap on the head of the middle metacarpal bone will cause pain in the region of the navicular in fresh fracture, *but not so in old fracture.* Navicular fracture never produces the silver fork deformity of Colles' fracture. The old fractures of the navicular are characterized by stiffness in the wrist, approaching a real ankylosis, weakened hand grasp and constant pain during use, which may have persisted for years in the region of the bone.

X-RAY EXAMINATION OF NAVICULAR FRACTURE

The roentgenogram naturally clinches the diagnosis. After a fresh fracture one must look very closely for the plane across the bone. As time passes after fracture the diagnosis becomes certain. Three to six weeks later almost any one may decipher the open plane across the bone and the bone absorption along the edges. *The bone being quite dead has retained its original density as of the time of accident.* Its shadow is therefore darker than the neighboring carpal bones which have undergone calcium loss in the atrophy of disuse, induced by pain. The mistake of considering a bipartite navicular as a fracture must be avoided. (Refer to my monograph mentioned.)

TREATMENT OF RECENT NAVICULAR FRACTURE

The treatment of recent navicular fracture—that is, a day or so old—is immediate immobilization of the hand, thumb, and wrist in a position of slight radial and volar flexion. This immobilization should last seven or eight weeks and should be followed by graduated active use, with daily baking by dry heat. If a happy outcome is desired, no pain should ever be set up by overuse or early hyperrange of motion of the wrist.

TREATMENT OF OLD NAVICULAR FRACTURE

For old fractures—and we call them old if they have gone undiagnosed seven days or longer—the best and most satisfactory treatment is carpalectomy of the navicular. No matter how many fragments are present, all the bone is removed. I find no reason for leaving the distal fragment: it always sets up irritation and eventually causes symptoms equal to old fracture. Two patients have come to me from whom the proximal portion of the fractured navicular was removed. After several years subsequent falls caused a volar dislocation of the lunate,—perilunar transnavicular dorsal dislocation of the wrist.

PROGNOSIS AFTER NAVICULAR FRACTURE

The earlier the bone is removed, the better the result. In cases of no greater duration than six months the prognosis is very good. If the fracture has existed five to ten years, the prognosis is not so good, but by taking out the entire bone pain can be completely, and stiffness partly, removed. If the carpus is truly in a condition of bony ankylosis, a wrenching of the hand into a cock-up position may improve the function, but a carpalectomy of the whole proximal row leads to better results. For these long standing fractures with bony ankylosis after carpalectomy of the proximal row, a fascial transplant is inserted in the radio-carpal joint as in arthroplasty. Active and passive use are started as soon as the operative wound has healed.

END RESULTS TO ILLUSTRATE THE VALUE OF FIXED TRACTION IN THE TREATMENT OF FRACTURES OF THE LOWER EXTREMITY*

BY H. WINNETT ORR, M.D., AND J. E. M. THOMSON, M.D., LINCOLN, NEBRASKA

The series of cases herein reported includes only those fractures of the lower extremity that have been treated by a fixed traction method and that have come under our care during the past five years. Sufficient time has elapsed since the incident of the fracture in each case to justify deduction as to the amount of disability. The cases have been carefully followed up by questionnaires, subsequent examinations, and radiographs.

The results are classified as good, moderate, and bad, considered from two standpoints, anatomic and functional. In the first instance, the anatomic apposition of the healed fragments is judged from examination, measurement, and Roentgen findings. In the second instance, the amount of functional return to normal performance of the extremity is estimated, due consideration, however, being given to the age, previous general health, and occupation of the patient.

By fixed traction is meant traction that is applied at the time when the fracture is reduced and so fixed in the immobilizing apparatus that it and the reduced fragments remain undisturbed and unaltered until at least preliminary healing has taken place. The exact technique as employed by us is as follows: Moleskin adhesive plaster traction straps are used, three inches wide, and varying in length according to whether they are to be used for fractures of the leg or thigh. The frayed ends of a pliable, strong rope are sewn into the distal end of the straps to be used for traction purposes. The straps are applied to both sides of the limb, well above the site of fracture (except when compound), and bandaged in place with muslin bandages. The patient is anesthetized on a fracture table; traction is instituted by the use of rope ends attached to the traction device by which the pull is made, and continued until the limbs are of equal length; the cast is applied in the usual manner as low on the extremity as the ankle. After the plaster has sufficiently set, traction having been continuously maintained by the foot bandage, the traction ropes are cut from the holding

* Presented at the Annual Meeting of the American Orthopedic Association. May, 1924.

device and turned back against the leg portion of the cast and imbedded in the cast by several turns of plaster bandage, thus anchoring them and

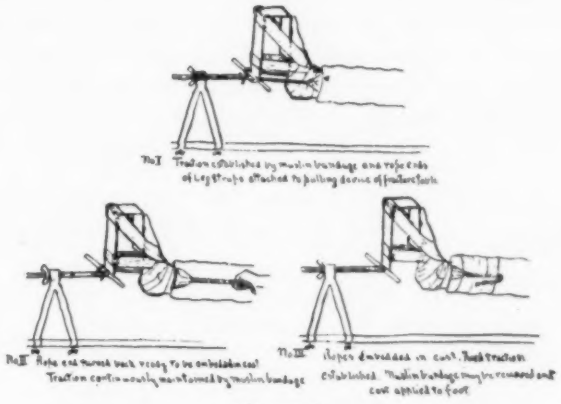

PLATE 1

Method of applying fixed traction by means of moleskin traction straps.

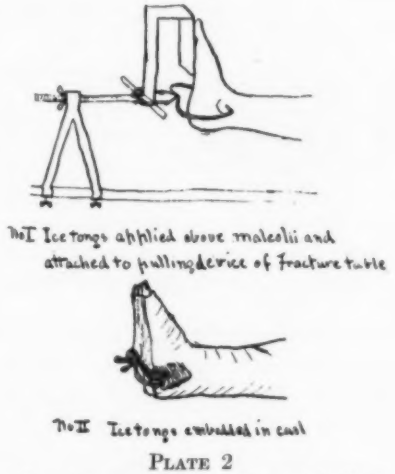

PLATE 2

Ice tongs used in the application of fixed traction.

maintaining the traction (Plate No. 1). The foot is then wrapped in sheet wadding and the cast applied with the foot at a right angle to the leg.

In some instances we have found it necessary to use tongs or pins applied just above the condyles of the femur, at the ankle or through the

heel. This may be done at any time when the fracture is near the joint and when it is difficult to maintain traction by other means. We do not use a pin in the ankle, but in several cases have put it through the os calcis. To fix the traction in these cases we imbed the pin or tongs in the cast before the holding ropes are released, thus fixing the constant pull of the appliance (Plate No. 2). This is a method of the greatest importance in those cases where exact position as to rotation, eversion, or inversion of the foot or the lower fragments is difficult to secure or maintain. Such exact

INTRACAPSULAR — 4 CASES

Treatment		all
Double Spica Cast		
Time 9 to 10 weeks		
Traction 1		
Moleskin Adhesive Straps		all
Splint		
Ring Caliper		all
6 to 9 weeks		
Deformity		
Slight		1 case
Shortening ½ inch		1 case
Results		
Anatomical	good	3 cases
	moderate	1 case
Functional	good	3 cases
	moderately good	1 case

Ages 5, 16, 56 and 75 years.

NECK — 17 CASES

Treatment		
Double Spica Cast		all
Time 8 to 10 weeks		
Traction		
Mole skin adhesive straps		all
Splint		
Ring Caliper		all
Time 5 to 9 weeks		
Deformity		
Moderate		6 cases
Shortening		
about ½ inch		5 cases
Results*		
Anatomical	good	9 cases
	moderate	6 cases
Functional	good	11 cases
	moderate	3 cases
	bad**	1 case

*Two cases aged 81 & 91 died during treatment

**Case had Progressive muscular atrophy. Ages 45, 50 and Fifteen over 75 years of age.

TROCHANTERIC — 6 CASES

Treatment		
Double Spica Cast		all
Time 8 to 12 weeks		
Traction		all
Straps		
Splint		
Ring Caliper		all
Time 5 to 9 weeks		
Deformity		
Slight		1 case
Shortening		
½ inch		1 case
Results		
Anatomical	good	5 cases
	moderate	1 case
Functional	good	5 cases
	moderately good	1 case

Ages 21, 35 and 4 over 75.

PLATE 3

Fractures in the region of the neck analyzed under three headings: Intracapsular, those of the neck, and those through the trochanters, treated by fixed traction.

position can be secured and accurately maintained by manual control of the ice tongs or pin until it is "frozen" into the cast in just the position as to length and rotation desired. Ice tongs and pins are often the only devices that will give this kind of control in compound fractures.

We have found a number of cases in which after full length was accomplished, apposition of the fragments could not be obtained. With several of these, before attempting extensive operative procedures, direct leverage applied to the fragments has given excellent position. Full length of the extremity is first attained with the patient on a fracture table. Then on the dorsal surface of the extremity over the fracture an incision is made long enough to permit the insertion of the index finger and an

instrument used as a lever. Next, with the finger as a guide, the lever is forced between the ends of the fragments and leverage applied to bring them into apposition(Plate No. 15). After this is accomplished the wound is closed, and the lever in this position is imbedded into the plaster-of-Paris cast. The lever is removed in ten days or two weeks.

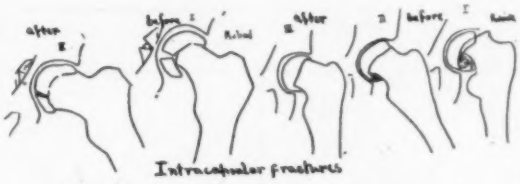

PLATE 4

Two cases of intra-capsular fracture of femur (Roentgen tracings) treated by fixed traction.

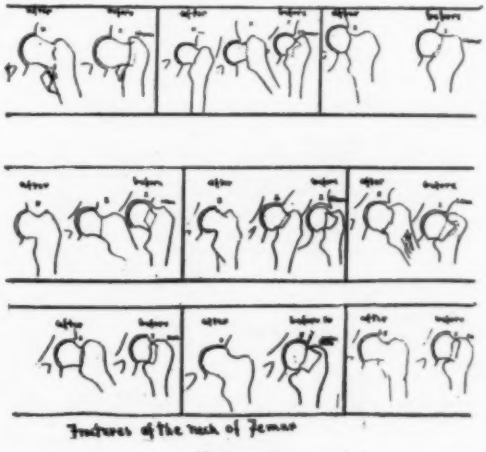

PLATE 5

A group of fractures of the neck of the femur (tracings) treated by fixed traction.

Of the thigh cases in our series there were but fourteen with the patient under sixteen years of age. Twenty-seven of the cases occurred in the region of the neck of the femur, and four were intracapsular; seventeen were of the neck and six of the trochanteric region (Plate No. 3). These patients were all placed in double plaster-of-Paris spica casts. The injured extremity was well abducted in all cases, the good leg moderately

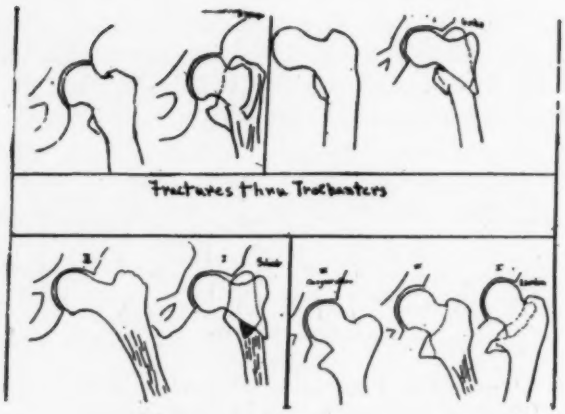

PLATE 6

Four fractures of the femur through the trochanter (tracings) treated by fixed traction.

UPPER THIRD FEMUR — 6 CASES		
Treatment		
Double Spica Cast		all
Time 8 to 11 weeks		
Traction		
Moleskin Adhesive Straps		all
Splint		
Ring Caliper		3 cases
Post Hip Splint		1 case
No Splint		2 cases
Deformity		
None		
Shortening		
None		
Results		
Anatomical good		all
Functional good		all
Ages Two cases under 15 years		
One case 20 years		
Three cases over 40 years		

MIDDLE THIRD — 16 CASES		
Treatment		
Double Spica		2 cases
Single Spica		14 cases
Time 8 to 9 weeks		
Traction		
Moleskin Straps		13 cases
Moleskin straps and lever		2 cases
Tongs		2 cases
Splint		
Caliper splint		all
Time 3 to 8 weeks		
Deformity		
Slight		1 case
Moderate		1 case
Bad		1 case
Shortening		
½ inch		1 case
¾ inch		1 case
*1½ inch		*1 case
Results		
Anatomical	good	13 cases
	moderate	2 cases
	bad	*1 case
Functional	good	14 cases
	moderate	1 case
	bad	*1 case
*Shortening operation performed 4 mos. previous to coming under our care.		

LOWER THIRD — 6 CASES		
Treatment		
Single Spica		all
Time 8 weeks		
Traction		
Straps		3 cases
Tongs		2 cases
Pin		1 case
Splint		
Caliper		2 cases
Post Iron		4 cases
Time 4 to 5 weeks		
Operation		
Nail used in one case after osteotomy		
Deformity		
None		
Shortening		
None		
Results		
Anatomical	good	all
Functional	good	all
Ages		
Operation		
Direct leverage		2 cases
Nail		2 cases
Osteotomy		3 cases

PLATE 7

An analysis of our fractures of the upper third, middle third, and lower third of the femur treated by fixed traction.

so. With the patient on the fracture table, full length was obtained by means of moleskin adhesive straps. After the cast had been applied and while traction was still maintained, the rope ends were imbedded into the plaster-of-Paris above the ankle, as previously described, thus fixing the traction in each instance. When the patient was placed in bed the foot

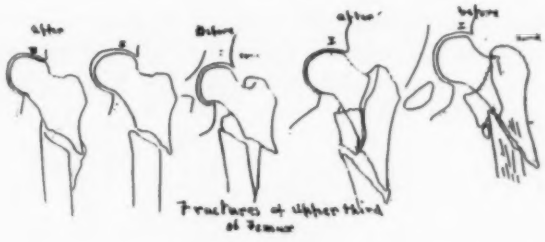

PLATE 8

Two fractures of the upper third of the femur (tracings) treated by fixed traction.

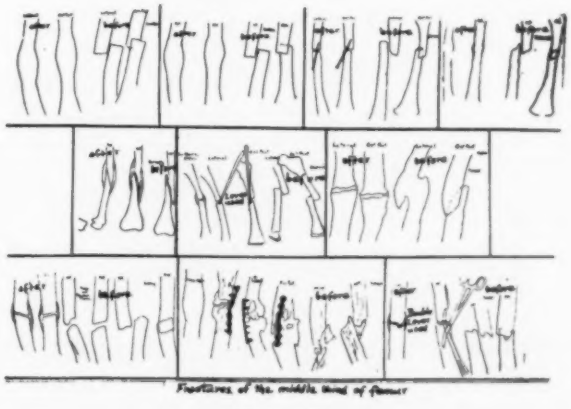

PLATE 9

A group of fractures through the middle third of femur (tracings) treated by fixed traction.

of the bed was elevated and moderate traction applied to the cross-bar between the legs. The usual precautions were taken in the matter of turning the patient frequently, etc. Our casts are kept on from eight to twelve weeks. Afterwards all patients are given full length caliper walking splints for from five to nine weeks. Crutches or canes are used for variable periods.

Of the four intracapsular fractures, three have good anatomic and functional results; one has a moderate deformity with one-half inch of shortening (Plate No. 4).

Of the seventeen cases of fracture of the neck, nine had good anatomic position and eleven had good return of function (Plate No. 5). Two of this series died early in the course of treatment, their ages being eighty-one and ninety-one. One other patient had progressive muscular atrophy of both lower extremities and died a year later, without having been able to walk. Six have moderate deformity, five have one-half inch shortening.

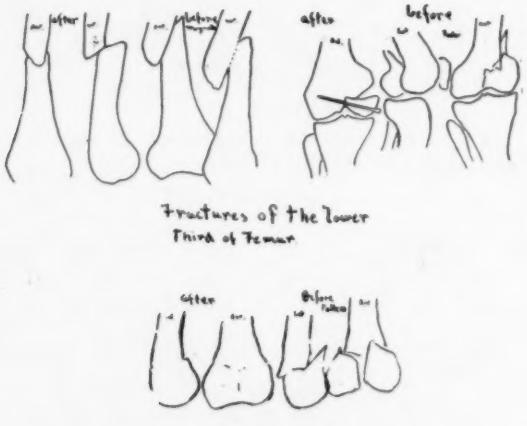

PLATE 10
Three fractures through the lower third of the femur (tracings) treated by fixed traction.

All of these patients were over forty-seven years of age, fifteen of them being over sixty-five.

Of the six patients with fractures through the trochanter (Plate No. 6), there was one-half inch of shortening in one and a moderate degree of lameness therefrom. The other five had good results. Four of these were over seventy-five years of age.

There were in all twenty-seven cases in the region of the neck of the femur, seven having an amount of shortening of not more than one-half inch. Seven had moderately satisfactory function; two aged women died during the course of treatment, and one other, due to disease, never recovered function of the limb. Union was satisfactory in every instance. It was not found necessary to resort to operative intervention in a single

case, and in those having but moderately good results only one had to use crutches or cane one year after the accident.

There were six fractures in the upper third of the shaft (Plate No. 8). All these patients were treated in a double-spica cast in abduction and moderate flexion, with the traction imbedded into the cast as previously described. They remained in the cast from eight to eleven weeks. Three of these patients wore caliper splints, one a posterior iron. Two had no splint applied. The results, both anatomic and functional, were all good.

FRACTURES OF LEG		MIDDLE THIRD — 23 CASES		LOWER THIRD — 12 CASES	
UPPER THIRD	3 cases				
Treatment		Treatment		Treatment	
Spica cast single	2 cases	Thigh cast	21 cases	Thigh cast	2 cases
Thigh cast	1 case	Spica	2 cases	Leg cast	10 cases
Time 8 weeks		Time 8 weeks			
				Traction	
Traction		Traction		Straps	2 cases
Tongs	2 cases	Straps	19 cases	Tongs	6 cases
Straps	1 case	Tongs	4 cases	Pin thru heel	4 cases
Splint		Splint		Splint	
Caliper	all	Short Caliper	21 cases	Short Caliper	3 cases
Time 3 to 6 weeks		Posterior Iron	2 cases	Posterior Iron	9 cases
Deformity		Deformity		Deformity	
Slight	7 cases	Slight	2 cases	Slight	5 cases
Shortening		Moderate	2 cases	Moderate	1 case
None		Shortening		Shortening	
Results		½ inch	2 cases	¼ inch	1 case
Anatomical good	all	Results		Results	
Functional good	all	Anatomical good	19 cases	Anatomical good	8 cases
Operation		Anatomical moderate	4 cases	Anatomical mod. good	3 cases
Direct Lever	1 case	Functional good	21 cases	Anatomical moderate	1 case
		Functional moderate	2 cases	Functional good	11 cases
Ages 15, 35 and 60		Operation		Functional moderate	1 case
		Direct Leverage	1 case	Operation	
		Approximation by sutures	2 cases	After apposition	1 case
				Direct lever	1 case
		Ages under 12 years	7 cases	Ages under 8 years	4 cases
		Ages over 22 years	15 cases	Ages over 20 years	7 cases

PLATE 11

Analysis of our fractures of the leg, treated by fixed traction, considered under the headings of fractures of the upper, middle, and lower thirds.

There were sixteen cases of fracture in the middle third of the femur (Plate No. 9). Two of these had double-spicas applied; fourteen, single spicas. Traction was established in fourteen of these by our fixed adhesive traction method. Tongs were used in two instances. Seven of these required open operation to accomplish reduction, and in two a single nail was used to maintain apposition during the application of the cast. Two other patients had moderate incisions to permit direct leverage on the fragments. In three patients who came to us because of malunion, osteotomy was performed.

Caliper splints were worn by each of these patients for from three to eight weeks. Two had some deformity; one, one-half inch shortening, the other three-fourths inch. One of the patients in this series had one and one-half inch shortening which was due to an operation performed previous to our care of the case. When he was admitted he had three inches of shortening. A loosened Lane plate was removed and the limb straightened. On account of slight evidence of infection we did not feel justified in doing more than this. He now has moderately good function and does not desire further correction.

Of the fractures of the middle third of the shaft, thirteen have good

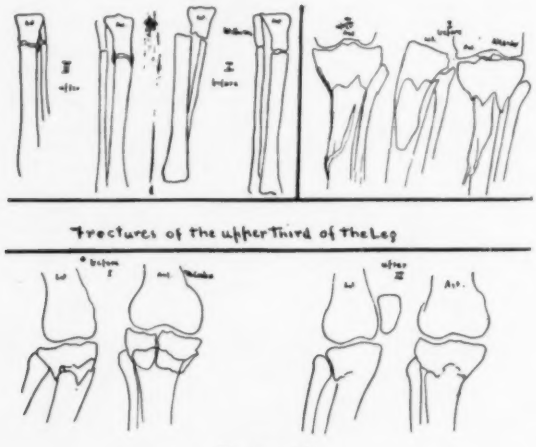

PLATE 12

Three fractures of the upper third of the leg (tracings) treated by fixed traction.

anatomic results. Three of the results are only moderate. Twelve had good functional results, two fairly good, and one moderately good. The disability in the latter case is due to his one and one-half inch of shortening.

Of the six cases of fracture in the lower third of the femur (Plate No. 10), a single spica with flexion at the knee was employed. Three were treated with adhesive traction; two with tongs placed just above the condyles of the femur and imbedded into the cast. One patient, in whom the fracture was just above the condyle and "T" shaped into the joint, had traction applied directly to this region by means of a pin through the condyles while direct traction was applied to the flexed leg. A nail was used for fixation after osteotomy of the condyle in one case.

After the casts were removed, posterior irons were used on four of these patients; caliper splints on two. The results in all of these cases were good (Plate No. 7).

In summarizing this series of fifty-five fractures of the femur treated by fixed traction, we find there were eight cases with one-half inch of shortening and two cases with three-fourths inch of shortening. There

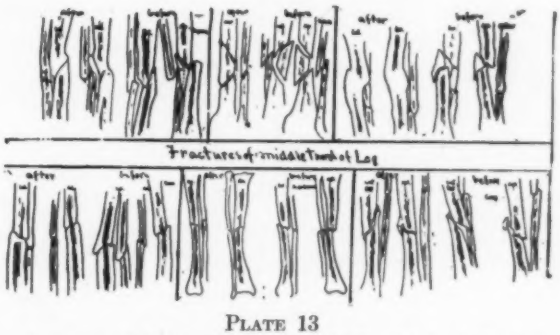

PLATE 13

A group of fractures of the middle third of the leg treated by fixed traction (tracings).

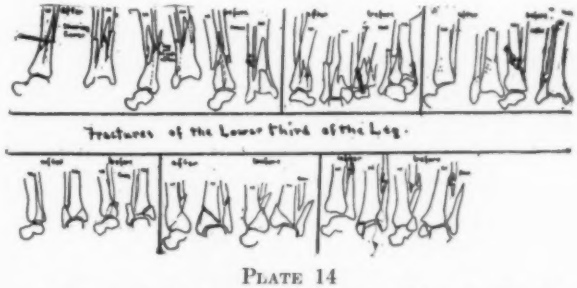

PLATE 14

A group of fractures of the lower third of the leg treated by fixed traction (tracings).

were nine cases having a moderate degree of disability. Operation was necessary in but seven cases, these being of the middle third of the shaft. Three of these patients had osteotomy performed by us to correct deformities that occurred while the patients were under the care of other surgeons. We did not find it necessary to resort to plates, grafts, or metal bands, and we consider that their use is superfluous in most cases. When occasionally we find it necessary to resort to open operation, we employ

no more than the simplest appliances, such as heavy chromic sutures, a lever applied directly to the fragments, or a finishing nail. These are employed even in such cases as purely temporary expedients.

We have had no cases, either of non-union or of malunion, that would constitute a disability in our series.

Our fractures of the leg are divided as follows: those of the upper third, the middle third, and the lower third (Plate No. 11).

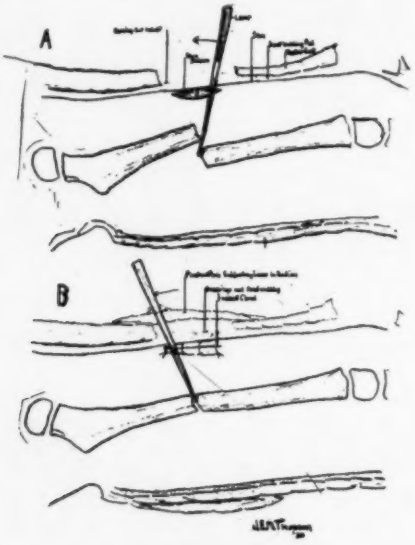

PLATE 15

After full length is attained and fixed traction established, apposition of the fragments can be accomplished by direct leverage.

We had three fractures of the upper third (Plate No. 12). Two were treated in a single spica cast, one in a thigh cast. Two had tongs applied at the ankle which were imbedded into the cast. In the other case traction straps were employed. A minor operation was performed in one instance to permit the use of direct leverage for reduction. The anatomic and functional results in these three cases were good.

Of the twenty-three fractures in the middle third of the leg (Plate No. 13), twenty-one had thigh casts; two had single spica casts. In nineteen cases traction straps were used and imbedded into the casts. In four, tongs were used. Open operation was performed in three in-

stances. Leverage was used on one of these, and in two the fragments of the tibia were brought into apposition and maintained by circular chromic sutures which were held in position by fastening them through small drill holes in the fragments. Short double lateral caliper splints below the knee were employed during convalescence in twenty-one cases. Posterior irons were used in two cases. Two patients of this series had one-half inch shortening. One of these was a patient with a compound fracture, who had already developed a severe osteomyelitis when he came under our care. The other was a patient with an old injury which was refractured by us in order to give a better weight-bearing line to the leg. Twenty-one of these twenty-three patients had good anatomic and functional results. Two were moderately good.

There were twelve fractures of the lower third (Plate No. 14). Five had thigh casts, seven had casts only to the knee. Six had tongs applied. Four had pins through the heel; two had traction straps alone. In each case the traction was imbedded into the cast. Three of these patients wore short double lateral iron splints during convalescence, while nine wore no splint after the cast was removed. There was slight deformity in five cases; moderate deformity in one. Shortening of one-fourth inch occurred in one case. Eleven had good functional results; one, only moderate.

In summing up our findings for the thirty-eight leg fractures treated in each instance by having the traction imbedded into the cast, thirty-five had uniformly good anatomic and functional results, while three had only moderately good results. Operation was resorted to in but three instances, and only the simplest direct methods of maintaining apposition were employed.

After this experience of almost one hundred cases treated with fixed traction without a single non-union, with less than one inch of shortening in any case, and in most cases good anatomic as well as functional results, we feel convinced that this method has proved to be superior to any other. There are those who still maintain that a certain amount of motion between fracture fragments is desirable and that the formation of callus and the healing of fractures is promoted thereby. It is our opinion that this is bad teaching, for the reason that in the best methods of splinting we now know, and especially as usually employed, undue mobility of the parts is the common cause of failure to get good results.

Joint stiffness from disuse after the fracture has healed can readily be overcome by physiotherapy. In those cases where the fracture is in or near a joint, return of function is much greater if the parts are protected

from irritation and further trauma than when ineffective fixation is employed or too early movement is tried. The pathologic changes that take place in an injured joint with a traumatic inflammation are similar to those of any other acute infectious arthritis and they respond similarly to absolute rest. By this procedure healing of the diseased surface is hastened and joint damage is minimized. If there is constant movement of such joints, productive or destructive changes occur which are irreparable.

Those who employ weight and pulley traction frequently refer to the necessity of using heavy weights for a long time. For example: Mr. Tubby, in a discussion of Mr. Dunn's paper before the Surgical Section of the British Medical Association in 1921, said: "With the glue extension, weights up to forty pounds could be maintained on the limb for some weeks without the strapping dragging away." One of our points is that no such amount of traction over such a length of time is necessary if length and immobilization have been attained at the original operation. Continued muscle spasm with a counter tendency to shortening, overlapping, deformity, etc., may, of course, result from failure of correction of the original deformity or failure to immobilize in correct position. With anything like correct treatment it is supposed that these failures are not to occur.

What is to be remembered is that full length and correct line having been obtained in the manner we have described, both the length and the position are to be maintained by the cast and the fixed traction.

After the first few days the traction may be said to cease functioning *as traction* and to serve from that time on simply as a factor in immobilization. This is true for the reason that there is a minimum of motion of the fracture fragments. There is little or no muscle spasm, and the plaster cast and the moleskin adhesive straps prove to be what splints *so commonly are not* — a true fixed dressing — with immobilization in correct position an accomplished fact.

AN UNUSUAL CASE OF PARAPLEGIA ASSOCIATED WITH MARKED GIBBUS AND A LOCALIZED COLLECTION OF FAT AT THE SITE OF THE GIBBUS*

BY ERNEST SACHS, M.D.,

Professor of Clinical Neurological Surgery, Washington University School of Medicine, St. Louis, Missouri.

In December, 1921, a boy fourteen years old, totally paralyzed below the level of the umbilicus, was brought into the hospital, referred by Dr. C. A. Stone. At the age of three he fell on a croquet ball and injured his left shoulder. There were no symptoms, however, until the age of seven, when the parents noticed that the left shoulder blade was becoming more prominent, and this increased. There was no pain at any time. In November, 1920, the patient noticed weakness of the legs. By January, 1921, he was totally paralyzed and had lost control of bladder and rectal sphincters. When admitted to Barnes Hospital he had a spastic paraplegia with complete motor paralysis of both legs, except for slight plantar flexion of the toes on the right foot. All forms of sensation were markedly diminished from the umbilicus down. There was marked Beevor's sign. The lesion was evidently at the region of the seventh dorsal spine which overlies the ninth and tenth spinal segments. The very marked deformity of the spine made it practically impossible to determine with any degree of accuracy where the tenth dorsal spinal segment was situated in reference to the vertebrae.

On account of a case that Dr. Ludwig Pick of Berlin had autopsied some sixteen years ago, and of which he gave me a photograph which I have treasured ever since, I felt certain that in this case I was dealing with the same condition that he had in his case: namely, that at the center of the curve of the kyphos there was a constriction of the cord, and opposite this point there was a large collection of fat. Figure 1 shows Pick's case, and this is exactly what I found at operation.

A laminectomy was undertaken under local anesthesia on December 23, but the patient collapsed, apparently from the effects of the novocaine,

* Read at the meeting of the American Orthopedic Association, Congress of American Physicians and Surgeons, Washington, D. C., May, 1925.

before the incision was started. One week later, on December 31, a laminectomy was done under general anesthesia. A mass of fat one to two cm. in thickness, which shaded off into the extra-dural fat above and below the gibbus, was found. The canal at this point was much larger in antero-posterior diameter than normally, and was much larger than just above and just below the gibbus. When this fat was removed, the spinal cord and dural sheath were seen to be greatly thinned out and compressed directly over a sharp angle formed by the bodies of the vertebrae. There was no

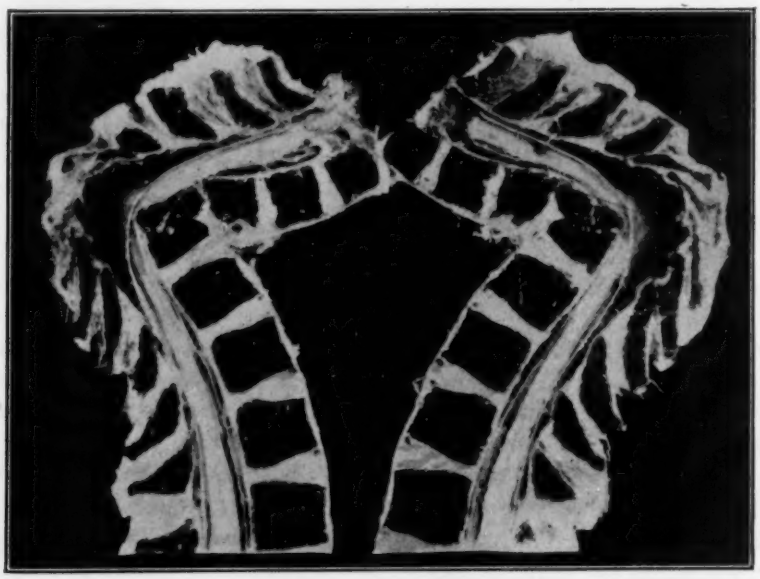

FIG. 1
Case of Dr. Ludwig Pick.

spicule of bone projecting backward. The spinal cord pulsated down to this gibbus, but below that point it did not. I therefore incised the dura longitudinally. The cord immediately prolapsed and pulsation began. I left the dura open and did a careful closure in layers to avoid a cerebrospinal leak.

In forty-eight hours the patient was able weakly to flex and extend his thighs and legs. The power rapidly increased and January 28, four weeks after the operation, he walked, and has been perfectly well since, but still wears a celluloid jacket. (Figures 2 and 3.)

FIG. 2

FIG. 3

This condition is so unusual that I have taken the liberty of presenting it before this society. There are a number of questions that have to be considered. First of all, was the spinal deformity an old healed tuberculosis and was the scoliosis superimposed upon an original kyphosis, or was this a pure case of scoliosis? Secondly, was the cord compressed by the mass of fat, an extradural lipoma, or did the fat merely develop at the site of angulation to fill up a dead space?

I have searched the literature very diligently for similar cases and have come to the conclusion that the condition is a very unusual one and its relief by operation even rarer. My search of the literature has been directed along these lines:

1st—Is there any record of a healed Pott's disease presenting this picture or running a course like this?

2nd—Are there any recorded cases of cord compression associated with scoliosis?

3rd—Are any of the cases of extradural lipomas similar to this case and have any of them been associated with a spinal deformity such as was present in this case?

4th—Is this collection of fat in the canal to be considered a true tumor, a lipoma?

I shall take up these questions in succession.

First, as regards this case being Pott's disease. I have read countless articles on the operative treatment of Pott's disease, and carefully read the descriptions of the operations, beginning with Macewen's article in 1888. This seems to have been the first satisfactory attempt to operate for Pott's paraplegia, and this brief article has been responsible for the operative treatment of Pott's paraplegia. Careful reading of Macewen's six cases has convinced me that two of them were probably not due to tuberculosis and were probably identical with mine. These two cases he describes as "cases of paraplegia with incontinence of urine and feces due to connective tissue tumor at seat of angular curvature of the spine completely cured by removal of tumor and laminae of vertebrae."

In every case of operation for Pott's disease the findings have been either an extradural abscess about the cord or tuberculous granulation tissue, and invariably the lumen of the canal has been narrowed. These two cases of Macewen are the only operative cases that I have been able to find which present a condition similar to mine. Another point of great interest to me is the size of the canal opposite the kyphos. Practically all authors, until very recently, have agreed that in Pott's disease the canal is either the same caliber or somewhat narrowed. Occasionally one

encounters a remark to the effect that at times the canal is wider at the point of compression, and at times one finds an illustration, as in Whitman's text-book, which shows a widening of the canal. The only very definite discussion on this point I have found is in a recent review on the operative treatment of tuberculous spondylitis by Borchers from Perthes' clinic,

FIG. 4

Abb. 2. Spitzwinkliger Gibbus ohne Wirbelkanalverengerung bei ausgeheilter Karies.
(Nach Wullstein)

which was read last year at the Surgical Congress in Frankfort. He mentions specifically and shows a picture taken from Wullstein, in which the canal is actually larger than normal at the point of angulation. (Figure 4.) Since such a condition can exist, one must consider whether the case here reported could be an old healed tuberculosis. My reasons for believing it is not are, first of all, the history of the case. There is nothing

to indicate that when this boy's deformity first appeared there were any symptoms suggesting Pott's disease. In fact, there were no symptoms whatever when the deformity was first noticed. Secondly, though a scoliosis may be associated with a kyphosis due to tuberculosis, such an

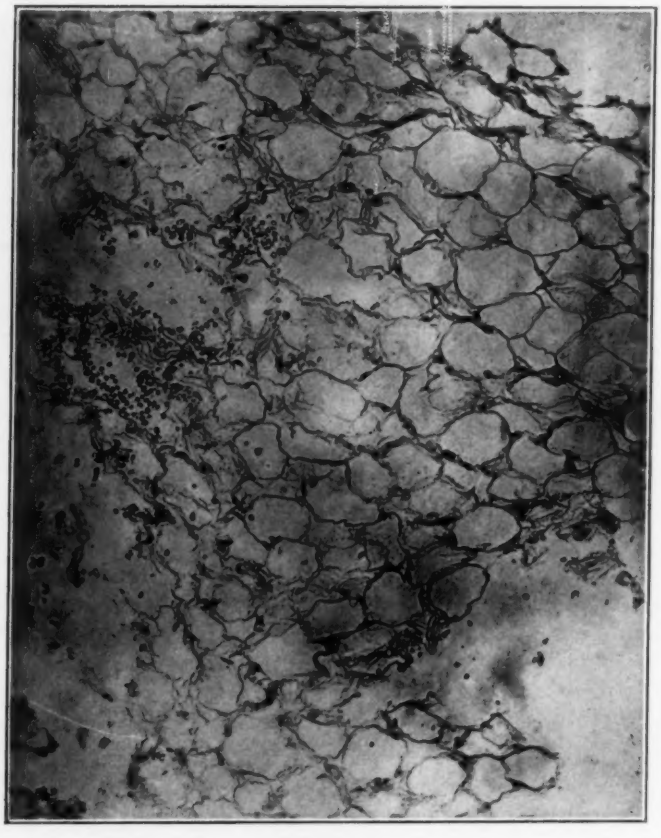

FIG. 5

extreme form of scoliosis is unusual. The histologic study of the fat removed over the compressed portion of the cord shows only fat and a very little connective tissue, but no evidence of any old inflammatory process, and nothing suggesting an old healed tuberculosis.

In the histologic study of this tissue I have had the benefit of Dr. Leo Loeb's opinion, and he concurs in this view, that this is merely a collection

of fat. (Figure 5.) One has to take into consideration the transformation that tuberculous granulation tissue may undergo in the course of years. One of two things may happen: connective tissue may be formed or areas of calcification surrounded by connective tissue. I can find no evidence in any of the text books on pathology that tuberculous granulation tissue could, when healed, be replaced by fat, as was found in this case.

Secondly, are there any recorded cases of cord compression associated with scoliosis? I have looked through all the standard pathologies in English and German, orthopaedic literature and neurologic literature. Kaufmann in his "spezielle Pathologie" says, "In spite of the most marked kyphosis the spinal cord practically never suffers from the kyphosis." Hoffa in his text book mentions having seen a case of rachitic scoliosis with paralysis of one leg. Kraske expressed the opinion that the paralysis in a Pott's disease was rarely due to the kyphosis itself, probably in not more than two per cent. of the cases. Gayet, on the other hand, in an extensive review, believes the gibbus itself is responsible for the compression, and not always the pachymeningitis externa. The generally accepted view in this country and abroad is that the gibbus rarely is the cause of compression symptoms. These are the only references that I have been able to find until Ridlon's article in 1916, when he reported two cases of scoliosis with pressure paralysis, and Kleinberg's case in 1922 before this Association. On that occasion Ely and Sayre each reported having seen a similar case. Those cases were treated by extension and ultimately slowly recovered. In my case, in view of the very long period of paralysis, I felt that laminectomy offered the patient the better chance and a more prompt recovery. There are, of course, cases of Pott's paralysis on record that recovered with the use of extension after paralysis had been present for weeks and sometimes months, but it did not seem to me that with a paralysis that had been been present for twelve months, and a rigid spine, extension could accomplish very much. The end result, I think, has justified the procedure here used.

The amazing and puzzling thing to me has been how to account for the fact that, in a disease as common as scoliosis, the conditions here found have so rarely been observed. Of course, the very extreme types of scoliosis, kypho-scoliosis, are not so very common, yet in the literature of the past fifty years one would expect to find such a condition occasionally mentioned. This brings us to the third point, whether the collection of fat could be a factor in this lesion. I have therefore gone over the literature on extradural lipomas. Bruns, in his book on tumors of the nervous system, states that the most frequent extradural tumor is a lipoma, but he

brings no evidence to substantiate this statement. The reported cases of this type of lesion that I have been able to find are very few, and a number of these cases have to be discarded because they belong to a very different group. I refer to the cases of collections of fat associated with a spina bifida occulta or a simple meningocele. These undoubtedly are a very different type than those in which the spinal column shows no congenital anomaly. The first authentic case of extradural lipoma was reported by M. Obré in the Transactions of the London Pathological Society in 1852. In 1857 Athol Johnson reported before the same Society what he believed was a similar case, but his undoubtedly was a collection of fat associated with a spina bifida. Virchow, in the same year, reported a case of malignant fat tumor, but this was what we today would call a neurofibromatosis or von Recklinghausen's disease. None of these cases was associated with a kyphosis or scoliosis. In the earlier literature of the subject the only cases I have found were those of Macewen already referred to. He speaks of the tissue as fibrous neoplasm, but he reports no histological studies of the tissue removed, and I believe his two cases may very well have had the same type of lesion that my case had. In the more recent literature on spinal cord tumors by Frazier, Krause, Elsberg and Stookey, extradural lipomas appear to be extremely rare. Frazier has gathered information about 330 spinal tumors, and of these but four are lipomas and none apparently was extradural. He says about lipomas that they are rare except in association with spina bifida. Ewing says the majority of spinal lipomas occur in children under five years of age, but goes into no discussion of the subject. Elsberg, in his recent book, reports two cases of lipoma, but both of these are intradural. In none of the cases, furthermore, was there an associated kyphosis.

This brings us to the last point: Should we call this a lipoma or merely hyperplasia of the fat which normally is found in the extradural space? A true lipoma has a capsule: this mass of fat had none; it was continuous with the extradural fat above and below the kyphos. I believe that this is an example of fat hyperplasia *ex vacuo* as described by Adami and other pathologists. It might seem, at first glance, quibbling to argue whether this fat was a tumor or merely fat hyperplasia, but as I see it, it is of vital importance in order to interpret this case properly. Any one who is doing many laminectomies has been struck by the tremendous variations that individuals show as to the quantity of extradural fat. This does not seem to vary with the deposit of fat elsewhere in the body. Thus, fat individuals do not necessarily have more extradural fat than thin individuals. I believe that though the general adiposity of an individual may be one

factor, it is by no means the only one, or the most important one. A tense dura might very well cause atrophy of the fat, a flaccid dura permit accumulation of fat. In more than a hundred laminectomies, I never recall seeing much fat when the canal was well filled by a dura. In this case, therefore, I believe the accumulation of the fat was merely an attempt to fill up a dead space in a spine in which the canal was wider than normal. When the kyphos was formed, the canal became wider than normal, as described by Borchers and Wullstein, and in consequence a dead space existed which was filled up by the hyperplastic fat tissue. This case is one in which the cord symptoms were produced by pressure of the kyphos and illustrates strikingly that that may be at times the method of production of paraplegic symptoms.

I believe, therefore, that we are dealing here with a case of paraplegia due to pressure on the sharp angulation of the body of the vertebrae in a case of scoliosis, with a secondary deposit of fat which, however, was not responsible for the compression symptoms.

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DISCUSSION

DR. J. T. RUGH, Philadelphia, Pa.: I feel myself utterly incompetent to discuss a problem such as Dr. Sachs has presented. I do feel that the Association is to be congratulated on hearing the exposition of a case of such a strange type. About all I can do in the discussion of the case is to ask Dr. Sachs a few questions. In the first place I should like to know the age of Dr. Pick's case of which he showed the picture. In the second place, Dr. Sachs mentioned nothing at all regarding the roentgen ray study of this spine. I have no doubt at all that a very careful study was made, but it would be of interest to know what were the pre-operative radiographic findings: whether, in other words, there was any evidence of bone destruction or bone pathology shown by the roentgenogram; also, whether there was any evidence of a constriction of the spinal canal. Another question I should like to ask he partially answered, but there was a discrepancy. Ewing made the statement that lipoma is the most common tumor in children before four years of age. Does Ewing's statement regarding that harmonize with the observations of the neurologic surgeons and neurologists who have seen such cases and have reported regarding them?

In regard to one other point mentioned by Dr. Sachs: I think it is the experience of practically all orthopaedic surgeons that cases of Pott's disease may have a paralysis existing for as long as two years. I believe there is one case reported by Goldthwait where the paralysis was present for three years and the patient made a recovery from the Pott's paralysis. Certain it is that we all see cases of Pott's paralysis lasting for a year or a year and a half and ultimately recovering completely.

This case is of intense interest and I want to express my appreciation to Dr. Sachs for presenting it.

DR. REGINALD H. SAYRE, New York, N. Y.: I would like to ask the same question as Dr. Rugh in regard to the roentgenogram of this spine. Judging from the picture that was shown of the other spine, I think in that case undoubtedly it was the tension caused on the dura by the collapsed bones which caused the paralysis, and as I understand his case, as soon as he split the dura longitudinally and relieved the tension the cord began to pulsate. I have under observation at the present time a case of Pott's disease with scoliosis forming which is almost identical with the picture of this boy shown today, and I have seen three cases of undoubted tuberculosis of the spine which later on developed a scoliosis apparently from the erosion of the spine, more on the lateral than on the anterior aspect, so that as time went on the scoliosis looked almost like an idiopathic scoliosis.

I am extremely interested in hearing this presentation today. I think it is a beautiful example of what can be done by intelligent treatment, although as Dr. Rugh says, many of these cases of Pott's paraplegia recover after a time, and in my experience not infrequently these cases have recovered by the occurrence of an abscess somewhere,

or when apparently a relief of the pressure was caused by an intraspinal abscess making its way along the line of least resistance and forming a psoas or mediastinal abscess which we could see in the radiogram, with relief of the paraplegic symptoms.

Dr. Leo Mayer, New York, N. Y.: I would like to ask Dr. Sachs to tell us what he thinks caused the spinal deformity if it were not tuberculosis.

Dr. C. A. Stone, St. Louis, Mo.: This boy described by Dr. Sachs had been kept in bed for some time under treatment before operation without any improvement in the paralysis.

Dr. Ernest Sachs, St. Louis, Mo. (closing the discussion): It is a very risky thing for a man to come before a special society and I confess I did it with much trepidation. What I was afraid of was that you would ask me something about the pathology of this case.

As to the age of Dr. Pick's patient, I do not remember exactly. It was, I believe, a young adult woman.

Regarding the second question about the roentgenographic studies: of course they were made. The reason I did not bring them or show them on the screen was that in the first place one always has to apologize for the plate. In the second place, there was no evidence of destruction of the canal at the location of the kyphosis. There was not, as far as we could make out, any disease in the body of the vertebrae, such as you see in tuberculosis. For those two reasons I did not show the plates. The deformity of the spine was so great, as you could see in the patient's pictures, that making plates was extremely difficult. Our roentgenologist and Dr. Stone, who saw the plates, will bear me out that they threw no light on the etiology of this condition.

Next, in regard to Dr. Ewing's statement about lipomas being present most frequently in children about the age of five: I am a very great admirer of Dr. Ewing and I am very fond of him, but I think many statements in his textbooks are just handed down and I do not believe this is an original observation. This is identical with the statement in v. Bruns's book and I believe it was taken from that book. We know from personal experience that this statement is not borne out by the observations of neurologic surgeons. I have been unable to find in children any record of lipomas except in cases where there was a spina bifida occulta.

The next question and the most important one, Could this have been an old healed Pott's disease? Of course, I am very well aware of the fact, and I have tried to bring it out in the paper, that Pott's paraplegia could be present for a very long time and then recover by conservative treatment. I think most men are agreed that in the pathology of Pott's paraplegia as a rule the lesion is an extradural inflammatory process; as Dr. Sayre said, either an abscess or granulation tissue. I worked years ago with Sir Victor Horsley, who was a great advocate of operating for tuberculosis. I have seen him open many spines, — not that I approved of it, — and invariably the region of compression was filled with a mass of typical tuberculous granulations, which had usually worked up from the anterior surface of the cord from the body of the vertebrae. Sometimes there was an abscess associated with it. In my case there was certainly no evidence at all to suggest that. Furthermore, in those cases of Pott's disease that have been operated on, though the cord is somewhat constricted and though there may be tuberculous tissue inside the dura, I think as a rule it is due to inflammatory tissue around the dura, which in some cases has extended inward and is responsible for the paralysis. The thing that has interested me greatly from what Dr. Sayre says and

from going over this case is that perhaps the orthopaedic surgeons are treating cases as old cases of Pott's disease that really have this condition; in other words, whether some of these conditions have not been identical with the one I have described. I do not think there can be any question that in this case, just as in that case of Pick's that I showed, the only thing to do was to operate. In the first place, it was an absolutely rigid spine. Extension would accomplish nothing. Second, when the dura was exposed and the fat removed, the cord did not pulsate and it was only when the dura was split longitudinally that the cord began to pulsate and the spinal fluid came.

Finally, then, what is the pathology of this case? I do not think it is an old healed tuberculosis. I had hoped to get some help and light on this very point. I am inclined to think that it is a scoliosis superimposed upon some congenital anomaly, possibly a so-called idiopathic scoliosis.

A SIMPLE METHOD FOR ELEVATING THE DEPRESSED ANTERIOR METATARSAL ARCH

BY BERNARD H. KYLE, M.D., LYNCHBURG, VIRGINIA

Numerous patients have consulted me with reference to pain and discomfort about the ball of the foot. To many of these the usual lifts inside the shoe and metal bars have not given satisfactory relief.

When Jones and Lovett's Text Book on Orthopaedic Surgery came from the press, a shoe with a metal bar screwed to the sole was observed on Page 626, Figure 665. It was very evident that if this bar was of the proper thickness it should give the proper lift, but here the difficulty arose of having such a bar at hand to fit all sizes of shoes and give all variations of elevation.

The idea was then conceived that it would be a very simple matter to make this lift of leather and fasten it to the sole of the shoe.

The next patient who came into the office requiring a lift stood in a proper type of properly fitted shoe. A pencil mark was made to locate the head of the first metatarsal bone on the inside of the shoe and the head of the fifth metatarsal on the outside of the shoe. The shoe was then removed and these two points connected by a straight line on the sole of the shoe. This line, of course, would indicate the anterior metatarsal joint line of the foot. A second line was drawn posterior an inch and a half and parallel to the first line. The shoe was sent to the shoe repair shop where the lift, as shown in the photograph, was made in a very short time. After the lift has been properly designed it is merely a triangular wedge which prolongs the sole backwards and shortens the shank. When the shoe is placed on a perfectly smooth surface the only part which comes in contact with the surface is the heel and apex of the lift, the sole clearing the surface at the toe about one half of an inch. It is very important that the heel be perfectly level, allowing the apex of the lift to touch along its entire border, thereby preventing any rocking or unevenness in walking. The amount of the lift depends largely on the comfort of the patient and not infrequently it is necessary to increase or lower the lift just a trifle.

When the patient stood in the shoe lifted in this way, the metatarsal arch was elevated, allowing the toes to drop. After wearing the shoe for two days the patient returned relieved of all discomfort. Such a lift has been used on about thirty cases with good results in all cases. The lift

may be used for the following conditions: metatarsalgia; callus under anterior arch; fracture of the toe; paralytic feet with depression of the anterior arch and dorsally flexed toes (selected cases); following operations

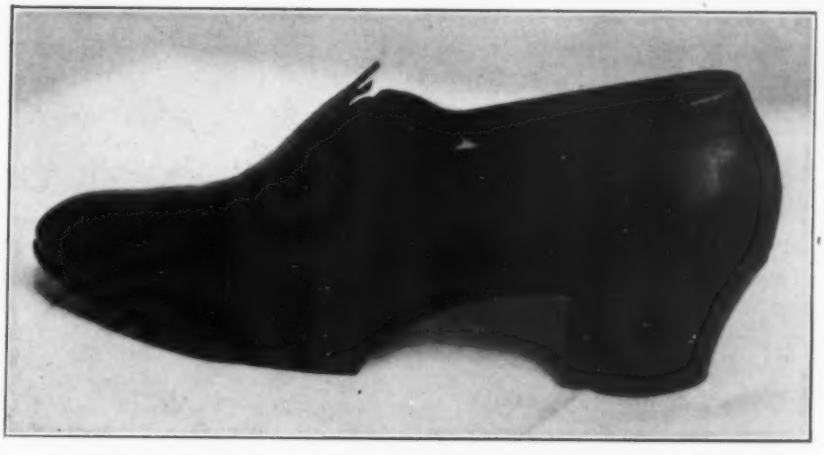


FIG. 1
Lift for anterior metatarsal arch—lateral view.

FIG. 2
Lift for anterior metatarsal arch—showing bar behind tread.

for hallus valgus. For the latter condition I have had this bar placed on the shoe prior to operation and have been able to get these post-operative patients up and allowed to walk at the expiration of the third week with comfort.

HIP FLEXION DEFORMITY AND EXTENSION FRAME FOR ITS CORRECTION

BY LEMUEL D. SMITH, M.D.

Children's Hospital, Boston.

The position of flexion, abduction, and outward rotation of the thigh is the passive attitude of rest and relaxation. Thigh flexion is one of the usual signs of trouble in or about the hip joint. Extension puts the joint under greatest pressure and is instinctively avoided. Consequently hip flexion deformity is common and requires correction frequently by conservative or operative measures. To facilitate both these methods of treatment this frame has been devised.

Control of deformity due to pathologic process in the joint itself is best supplied by some form of traction in the line of deformity and not by any leverage which makes of the diseased joint a fulcrum.

There is a group of cases, however, in which the joint itself is not involved, where the flexion deformity is due to contraction of soft tissues as a result of habitual posture, unbalanced muscular power, gravity, functional use, compensatory distortion, causing resistant flexion of the hip. This condition, if persisted in, is accompanied by increased compensatory lordosis of the lumbar spine with forward tilting of the pelvis. This group is usually amenable to correction either by continued mechanical effort or by fasciotomy with subsequent control in the correct position, and in these cases leverage action of the femur may be safely used.

Many methods are inadequate in these cases because they fail to control either lumbar lordosis, tilting of the pelvis, external rotation or abduction of the femur in the attempt to gain extension. A well fitting plaster jacket carefully molded over the ilium, particularly about the anterior spines, and carried well up the back will hold the pelvis quite well so long as it fits.

It has been the practice at the Children's Hospital to apply such a jacket and a plaster cylinder to the affected leg. The patient was then placed supine on a Schwartz or Stewart platform or on a box in such a position that the legs hung free over the edge. They were suspended and gradually lowered to gain extension. It was here that difficulties were further encountered. As the leg is extended it tends naturally to abduct

and externally rotate, for in this position there is less tension on the thigh flexor muscles, *i. e.*, they continue to occupy the relative position of a bowstring to a bow instead of being stretched over the convexity of an arch. The patient also deliberately assumes this position because it is more comfortable. Of course this defeats the end sought, for if the leg be extended posterior to the axis of the trunk, but abducted and externally

FIG. A

The long rods are made of ½ x ⅛ machine steel. They are found to be sufficiently rigid to support a small child up to two to three years old. They are flexible enough to be bent by hand without removing the frame from the patient.

rotated, it is not, properly speaking, in extension. It must be kept in neutral position in regard to rotation and abduction. It is the last two positions especially that this extension frame was provided to control while gaining extension. Also the patient is either sliding headwards on the platform or sliding off altogether. If he is in the correct position the edge of the platform is apt to cut into the buttocks. To meet these disadvantages an iron frame is contrived lifting the patient's buttocks away from the platform (see Figure B) holding the legs in adduction and with the bent foot-piece controlling rotation of the limb.

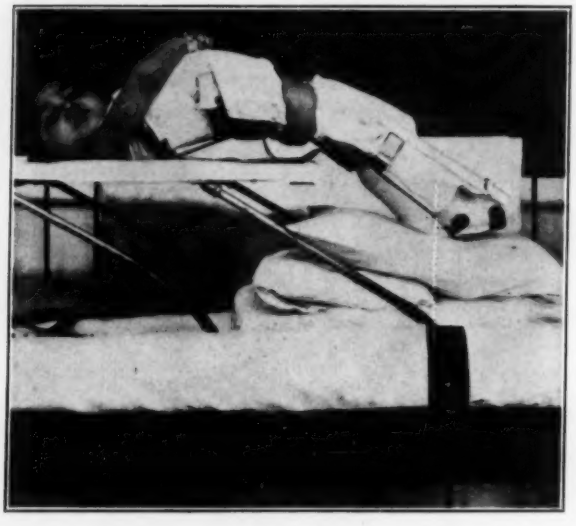


FIG. B
The frame shown in A applied to patient.

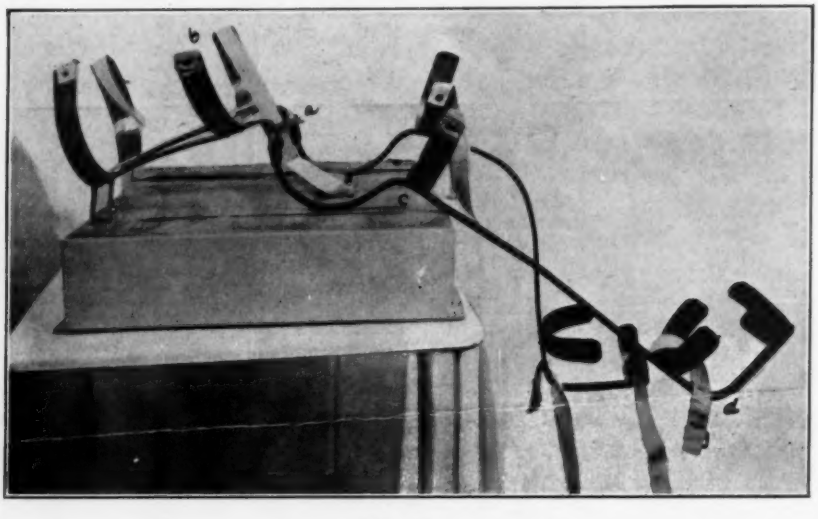


FIG. C

This frame is designed for larger children. The long rods are $\frac{3}{16}$ x $\frac{5}{8}$ machine steel. They are quite rigid and have simple joints at *a* made by twisting ends of rods 90 degrees and boring holes through them and one of the holes is threaded. A thumb screw and wing nut holds it at any angle desired. The foot piece (*d*) is a modified crab.

APPARATUS

In small children up to two or three years of age the long strips are made of one-half by one-eighth inch soft machine steel. These are found sufficiently rigid to maintain position, but flexible enough to allow them to be bent manually from time to time in order to increase the correction

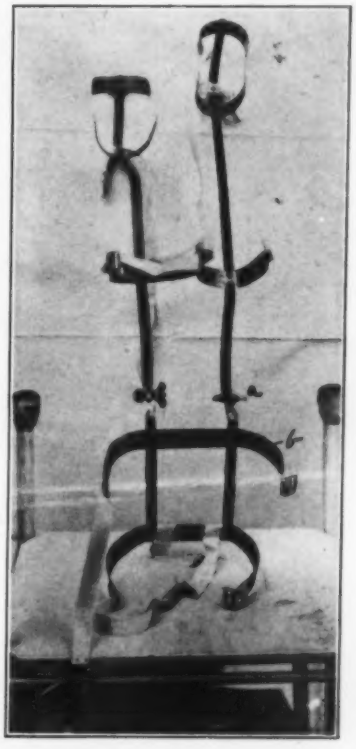


FIG. D
Shows details of joints A.

without removing the frame from the patient. In larger children we use three-sixteenths by five-eighths inch soft steel bars; these are not so flexible and require a joint with a thumb screw. (See (a) in Figures C and D.) This joint is cheaply made by twisting the ends of each rod ninety degrees and boring holes through. It is best to thread one of these holes and then to use a set screw against it. The steel rods are riveted to strap

iron bands, as shown, with webbing straps riveted to the bands. It will be noticed in Figure C that the line from (a) through (c) to (e) is a straight line, *i.e.*, there should be no bend at (c) with reference to the frame as a whole. This would cause an anterior thrust against the proximal thigh, which is to be avoided.

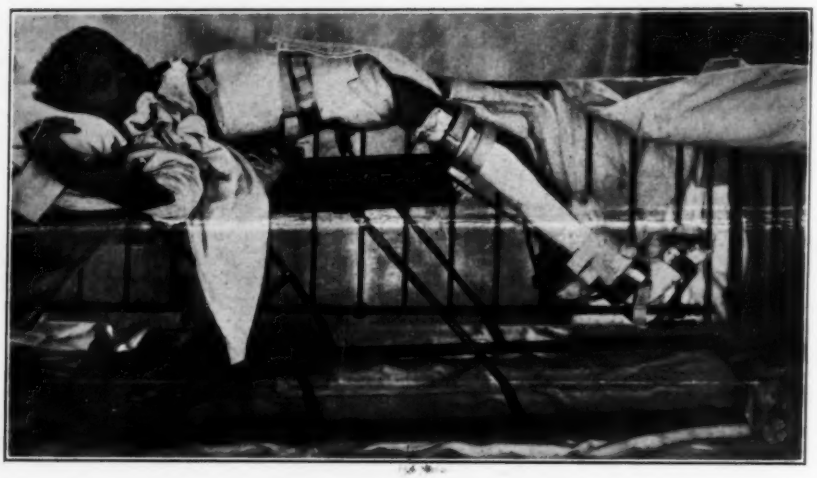


FIG. E
Shows the jointed extension frame on patient elevated on a Schwartz platform.

METHOD OF APPLICATION

In applying the plaster jacket it is well to make it thickest just below the crest of the ilium where the band (b) carries the weight of the body, then carrying the plaster well down to the crease of the buttocks, but gradually thinning it out so the cast is flexible here and will adapt itself to the contour of the body as the thighs are extended. This form will be comfortable. It should not then be trimmed back. Doing so causes the flesh to crease over a rigid edge, and the higher it is cut the worse it becomes. A leg plaster, thinned out at the proximal end, is then made, coming well up to the hip joint. When the plaster is dry it is bivalved and only the posterior part is used.

In very marked and resistent flexions the Soutter fasciotomy is indicated. Stewart[1] gives an excellent brief outline of the post-operative treatment which this frame is found to facilitate.

In devising this frame the thought of the patient's comfort and increased facility in nursing care as well as control of correct position was kept in mind. It is found that not only can the patient be kept in the desired position at all times, but that he is much more comfortable in it than out of it. It also facilitates the use of the bed pan and is conducive to greater cleanliness.

REFERENCE

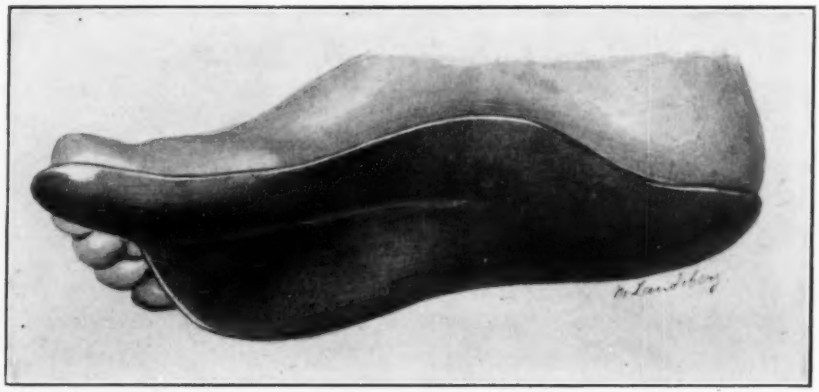
[1] S. T. Stewart, Journal Bone and Joint Surgery, IV; 548-551, July, 1922.

A FOOT PLATE FOR OSTEOARTHRITIS OF THE GREAT TOE

BY ARTHUR KRIDA, M.D., F.A.C.S.

Assistant Surgeon to Out Patients, Hospital for the Ruptured and Crippled, New York

Osteoarthritis of the first metatarso-phalangeal joint manifests itself by a painful restriction of motion and by exacerbations of inflammation in the soft structures about the joint. The recurring chronic strain which



ambulation imposes upon the joint can be satisfactorily controlled by the foot plate shown in the illustration.

So far as I know, a foot plate for this purpose has not been previously described.

The plate is shaped on a plaster-of-Paris model of the foot. The toe portion is made to extend to the end of the great toe, and is somewhat hollowed out to accommodate the toe.

CLINICAL CONFERENCE, HOSPITAL FOR THE RUPTURED AND CRIPPLED, NEW YORK, DECEMBER, 1924.

DR. R. WHITMAN—Avulsion of Tibial Spine with Rupture of Anterior Crucial Ligament. Operation, Removal of Fragment.

Dr. Whitman presented a child operated on for detachment of the anterior crucial ligament. The patient, a girl seven years of age, was admitted to the hospital October 17, 1924. About seven months previously, she had been struck in the knee by a swing. This was followed by pain and swelling and inability to completely extend the leg.

On examination nothing abnormal was found except slight limitation of extension of the right knee. The roentgenogram showed what appeared to be a fragment of bone lying in the anterior portion of the knee joint. On October 20, 1924, the joint was opened by an incision on the inner side of the patella. The fragment of bone was found to be the tibial attachment of the anterior crucial ligament lying loose in the joint, presenting below a corresponding depression in the tibia. This was removed, together with the ligament.

There is at present no limitation of extension and no functional disability, indicating that at this age at least the anterior crucial ligament may be dispensed with.

DR. R. STEPHENS—Case of Myositis Ossificans.

It is not uncommon to see myositis ossificans in the arm after dislocation of the elbow. Many cases have been reported and the cause is attributed to the stripping-up of the periosteum of the humerus at the time of the dislocation. In some it is said to be due to frequent trauma of a lesser degree. The two cases presented have both of these factors in the histories.

Case 1—M. T. age 32, first seen August 13, 1924. Patient stated that on June 30 she fell out of an upper berth on a boat and struck her left hand in landing. There was a dislocation of the left elbow which was reduced within a few hours, and a splint was applied for three weeks with the elbow in full extension. The joint was still and was manipulated under gas three times a week until she came under our observation, which meant about twelve such treatments. Examination on August 13 showed that the left elbow was markedly swollen and extremely tender. There was no rotation present and only five degrees of flexion with A. G. E. 90 and A. G. F. 85. A roentgenogram revealed a fracture of the head of the radius, some apparent callus about this site and also at the olecranon. The next day an operation removing the head of the radius was performed. It was then found that motion was free without any force from A.G.E. 160 A.G.F. 45 degrees, and pronation and supination complete. The wound healed by primary union and all discomfort was gone in about three weeks. Heat and diathermia were begun in a week, but active and passive motion were not started for over three weeks, as roentgen ray examination showed the increasing ossification in the brachialis anticus and triceps up to this time. From then on the pictures showed a slow but definite decrease in osseous tissue. Motion increased slowly, so that by the end of two months there was about 25% of the normal range of rotation and motion from A.G.E. 100 to

A.G.F 80. In an endeavor to increase the function an elbow brace was then made with a lock joint which could be adjusted to vary the position of the joint. Unfortunately the patient has since had pleurisy and has been away for possible pulmonary tuberculosis, and treatment for the elbow, I fear, has been abandoned.

Case 2—D. S. age 42. On August 2, 1924, patient fell five or six steps and struck on her left forearm. Says she had a dislocation of the elbow which was reduced without an anesthetic. Adhesive strapping was used for three weeks, then manipulations twice a week, the first five without an anesthetic and the last twelve under chloroform. She came to the clinic on November 3, at which time motion was present from A.G.E. 110 to A.G.F. 100. There was a bony mass on the anterior surface of the lower end of the humerus. The roentgenogram showed bone in this region which extended up into the brachialis anticus. Since then she has been having physiotherapy, and a picture taken after one month showed a decrease in the ossification. It is now planned to remove this excess bone in two or three weeks, as it has probably passed the peak of production. The conclusions derived from the study of these two cases are:

1—Ossification in muscles not infrequently occurs following dislocation of the elbow.

2—Forceful manipulations undoubtedly are harmful in such cases and may be responsible for the ossification, or at least for its increase.

3—Diathermia is apparently very beneficial in limiting the process and in aiding absorption.

4—Active and passive motion should not be started until the process has been checked as observed by the roentgenograms.

Dr. A. Whitman—Sacroiliac Arthrodesis for Gross Displacement.

Dr. Armitage Whitman presented a case of relaxation of the sacroiliac joint in which the Smith-Petersen operation had been performed. The history is as follows:

The patient was first seen by Dr. Whitman in consultation at the Lincoln Hospital, where it was stated that six months before, during the instrumental delivery of her second child, she had suffered a severe injury to her pelvis. On attempting to get out of bed on the tenth day she experienced extreme pain in her back and down both legs, absolutely incapacitating her. She remained in bed without medical attention for five months, at the end of which time she was admitted to Lincoln Hospital on the gynecological service for operation for rectocele and cystocele. It was then noted that she had an extreme separation of the symphysis pubis, on which account consultation was requested. She was transferred to the hospital for Ruptured and Crippled.

Physical examination made on April 25 is as follows: The patient was in good condition, somewhat over-weight. She got out of bed with great difficulty and evidence of extreme pain. She was able to walk by clinging to the bed and moved with a peculiar swaying gait. Motions of both hips in all directions, particularly abduction, were restricted about one half by pain and muscular spasm. Straight leg raising was limited at a right angle, but apparently was not more painful than other motions. There was tenderness over both sacroiliac joints and considerable tenderness on indirect pressure over the iliac crest, apparently more severe on the right side. There was no tenderness over the sciatic nerves. Motions of the lumbar spine in all directions were limited and painful, pain being referred to the region of the sacroiliac joints. Vaginal examination showed a very marked cystocele and a separation of the symphysis pubis to a width of about one inch. The bones, however, were connected by a firm band of fibrous tissue

about one inch wide by one-quarter inch thick. There was very slight tenderness in this region, on which account it would seem that the disability was due to relaxation of the sacroiliac joints rather than that of the symphysis pubis. Roentgenogram showed a separation of the symphysis pubis to the extent of about one inch. There was also apparent relaxation of both sacroiliac joints, more marked on the right side. The inferior margin of the joint showed a separation to about one-quarter inch.

A typical Smith-Petersen operation was performed on April 28, 1924. Because of the general relaxation of the pelvis a double plaster-of-Paris spica was applied. Five days later she was completely relieved of pain for the first time since her delivery. On the twelfth day the patient suffered a chill, temperature rose to 103 degrees, and several ounces of dark red, cloudy fluid were evacuated from the wound. A culture was taken from the fluid, but was lost. The wound was healing by granulation and progressing steadily until the twenty-second day, when it became infected with bacillus pyocyaneus. She was allowed to sit up at the end of the sixth week; she got out of bed and began walking on the fifty-third day. She walked deliberately but with no trace of the former peculiar swaying. She was, apparently, completely relieved of pain and was discharged at her own earnest request.

When shown in the clinical conference the patient walked without a limp. All movements at both hips, including straight leg raising, were free and painless; violent indirect pressure over the iliac crests elicited no pain. There was slight tenderness to pressure over the scar. Except for this tenderness the patient appeared normal in every way, and according to her own statement was completely relieved of disability.

DR. HANSSON—Diathermy.

The word diathermy means heating through, and the same thing is expressed by the terms endothermy, high frequency thermopenetration, direct d'arsonval, etc. The diathermy machine is a high frequency machine producing a relatively low voltage, high amperage current with one to two million oscillations per second. We all know that an electric current passing through a conductor develops heat, depending on the resistance of the conductor and the intensity of the current. In the same way, we have the diathermy current producing a heating through of the living tissues of the body traversed by it between two electrodes. This conversive heat production is the only effect, there being , as far as we know, no contraction, shock, or electrolytic changes.

The use of diathermy may be surgical and medical.

A. *Surgical diathermy* or electro-coagulation is simply a cooking process obtained when a large electrode and one of pin point size are used. The heat at the small electrode is sufficient to coagulate tissue cells. This has a wide application in removal of superficial growths.

B. *Medical diathermy* may be either stimulative or absorptive and sedative. In medical diathermy two electrodes, usually of the same size, are used, connected with the machine by means of two cables. The dosage is calculated from the size of the electrodes and the resistance of tissue traversed, but the best indication is the tolerance of the patient. The difference between stimulative and absorptive diathermy is in the technique. 1. Stimulative. Current is turned on suddenly up to about 700 mamp. for six or seven minutes and is turned off suddenly, no great heat being formed thereby and the object being to irritate the tissues to greater activity of the normal process taking place between the electrodes.

Case. This man, 40 years old, sustained a fracture of both tibia and fibula, middle

third, about Sept. 20, 1924. He was treated with immobilization in plaster, but when he arrived at this hospital a month later roentgenograms showed no callus and clinically there was no union. Patient presented same picture on November 7, when stimulative diathermy was instituted. Clinical examination today shows fairly good union so that patient can hold his leg up, and the last roentgenograms (December 5) show beginning callus formation.

2. Absorptive or sedative diathermy. To produce this effect a higher amperage is necessary, sometimes up to 2000 mamp. or more, for a period of 15-45 minutes. The current is turned on slowly and the treatment terminated by turning it off gradually. The immediate effect is increased heat production, the head regulating mechanism of the body responds with a local hyperemia, followed by local phagocytosis, stasis is broken up and now dissolved deposits made soluble. The sedative action follows the heat and hyperemia.

Case 1—Boy, 9 years old, sustained a supracondylar fracture of left humerus on August 21, 1924. Fracture was reduced and arm put up in acute flexion and supination by means of P.P. splints. He was sent for physiotherapy on September 4, when measurement taken showed flexion to 75 degrees, extension to 90 degrees. Range of motion of the left elbow, 15 degrees. On October 7 patient's mother was much worried over a swelling that had appeared on the left arm. On examination there was a hard, immovable mass, the size of a hen's egg, over the lower anterior third of the humerus. Roentgenograms showed beginning myositis ossificans. Patient was given diathermy, absorptive doses, 1000 mamp., for thirty minutes by cuff method preceded by radiant light but no massage. Today patient has perfect motion in left elbow, the tumor has disappeared, and there is no sign of myositis ossificans.

Case 2—Patient, 27 years of age, a printer. In 1921 developed severe abdominal pains and neuritic pains in all extremities. He was operated on for appendicitis in 1923 and cystoscopic examination made twice without any result. Was admitted to this hospital September 6, 1924. A diagnosis of plumbism was made. Abdominal pains were not severe, but pains in extremities worse than before. Patient was treated with sedative diathermy preceded by radiant light from day of admission until discharged on October 31. He was then free from pain and has been well since.

Conclusion: Diathermy when properly used is a valuable addition to our therapeutic agents. It should be used for a definite physiologic purpose to relieve a definite pathologic condition.

CLINICAL CONFERENCE, HOSPITAL FOR THE RUPTURED AND CRIPPLED, NEW YORK, JANUARY, 1925.

DR. R. WHITMAN—Chronic Synovitis of Knee. Operation.

Dr. Whitman presented two cases of chronic synovitis of the knee treated by open operation. The first patient, a man 35 years of age, had been injured in February, 1923. A synovitis had persisted, for which he had been tapped eight times, drained for a week, and treated at various times by support and traction, and a year ago had had the internal semilunar cartilage removed without permanent benefit. When first seen in

December, 1924, there was tense swelling of the joint, extending two or three inches above the patella. The joint was opened by a long, lateral incision and the patella was displaced outward. The interior appeared to be fairly normal except for the usual marginal encroachment of fibrous tissue on the cartilage. The hypertrophied fat was removed beneath the ligamentum patellae and the entire interior of the joint was then vigorously rubbed with gauze until bleeding was induced with the object of promoting adhesion of the apposed surfaces. The operation was successful. There was no return of the synovitis and the chief disability that persisted was due to muscular weakness.

The second case was in a man 42 years of age. Four years previously the knee became swollen and painful as a result of a general arthritis, and this had persisted in the knee after recovery in the other joints. The joint was enlarged by a tense synovitis and by evident thickening of the tissues, and motion was considerably restricted. The joint was opened by a long, lateral incision and found to contain a quantity of transparent, jelly-like material. The synovial membrane was very much thickened and was removed practically entire. The cartilage of the joint was in good condition. The operation, which was performed only ten days previously, had caused but little disturbance and the prognosis seemed to be good.

Dr. P. W. Roberts—Astragalus Transplant for Destruction of Head and Neck of Femur following Sepsis.

The patient was a girl eight years of age whose right femoral head and neck were completely destroyed by disease four years ago, causing an extreme limp. Eight weeks ago the upper end of the right femur was exposed and its medial surface freshened. An astragalus removed half an hour before from a paralytic foot was cleaned of fibrous tissue, its body cut across on the plane which, when the fresh surface was placed against the freshened surface of the upper end of the femur, gave an obliquity to the graft approximating the normal angle of the femoral neck. The astragalus was then placed in the acetabulum and bolted to the femur, with the freshly cut surfaces in apposition. A plaster spica was loosely applied to permit traction when the patient was returned to bed. The roentgenograms now presented show the condition of the graft. Nutrition appears to have been maintained, so far as roentgen ray evidence goes, and a clinical examination of the hip shows it to be stable. The child will be kept in bed with traction for two weeks more and then allowed up, wearing a Thomas knee brace on the operated side and an elevated shoe on the opposite foot.

Dr. A. Whitman—Fusion of Knee with Bone Pegs. Result after Four Years.

Dr. Whitman presented the case of E. K., 19, clerk. Complaint: pain in left knee. Well until April, 1919, when gradually increasing pain and stiffness in the knee began. Nine months later knee began to swell. Knee was aspirated and a cast applied. In August, 1920, pain became much more severe and he was totally incapacitated. Was brought to the hospital on a stretcher. He thought he had had fever and night sweats and was certain that he had lost weight. The patient was found to be in poor condition; evidently in pain, with general enlargement and infiltration about the knee. The knee was fully extended, and motions were not tested because of extreme pain. For the same reason no measurements were taken. Very marked atrophy of the thigh. The leg below the knee was edematous. Roentgenogram showed very great atrophy of all the bones, evident destruction of the cartilage, and a general cloudy appearance of the adjoining bone, as if the disease were of a deep-seated nature. Excision advised. The prognosis was not good.

Nov. 22, 1920, fusion of the knee with insertion of bone pegs. Joint contained a considerable quantity of thick, greenish pus. Synovial membrane grayish, edematous, hypertrophic. Joint cartilages, semilunar cartilages, and crucial ligaments practically destroyed. No deep foci in the bone observed. Jan. 6, 1921, plaster-of-Paris removed. Wound closed except for an area of superficial ulceration at the upper and external end of the incision. A few drops of thick pus extruded on pressure. About five degrees of motion in the joint. Since the operation has had no pain. A fenestrated P.P. applied. Jan. 22, 1921, began weight bearing. Aug. 25, 1921, P.P. changed. Union almost firm. Jan. 31, 1922, patient wearing a brace. Still a few drops of pus discharged per day. No pain. General condition excellent. Roentgenogram showed patella firmly united to tibia and femur. There was a slight space between the tibia and femur, which was slowly closing in. Bone pegs showed little, if any, absorption. Jan. 13, 1925, patient has discarded all apparatus. Union firm. Sinuses closed. General condition excellent. Roentgenogram showed the joint-line completely obliterated. Bone pegs still present. No absorption or rarefaction evident about them.

Dr. Armitage Whitman showed this case first from the standpoint of cure of tuberculosis of the knee by means of operation. He thought it also of interest as showing the complete tolerance of the tissues to beef-bone pegs, as shown by the fact that there was no rarefaction of the adjacent bone. It also illustrates the fact that bone pegs, although we regard them as absorbable material, in some cases are not so. He thought that in operations of this type the pegs were of service in providing practically complete internal fixation at the time of operation. It seemed to him that patients in whom the pegs had been employed suffered much less post-operative pain than those in whom fixation had been secured by plaster-of-Paris alone.

Dr. A. Krida—Traumatic Hypertrophic Synovitis. Synovectomy.

Dr. Krida reported the case of a man, 33 years of age, upon whom he had operated for a disability of the knee of five years' duration. The condition had its onset in a severe wrench of the joint. There was pain, swelling, and disability. An earlier roentgenogram presented an excavation in the external condyle. There had been numerous consultations and a great deal of physiotherapeutic treatment. One prominent consultant thought the condition tuberculosis. During the last few months a cystic swelling had developed at the back of the joint.

At operation four months ago the cyst was excised and was found to contain three small osteocartilaginous bodies. The joint was then opened anteriorly through the general utility incision. The synovial membrane was bluish white in appearance. In certain situations it was very thick, presenting excrescences of a fibrotic nature. This change was most marked in the pouch alongside the external condyle, in the outer aspect of the articular surface of which there was a triangular defect one-half inch in diameter characteristic of old osteochondral fracture. The fat pad and synovial tissues of that region were considerably thickened and fibrosed, the fibrosis extending to the semilunar cartilages and to the anterior crucial ligament. All these redundant masses were excised.

The condition apparently represented a terminal and unusual phase of osteochondral fracture, differing from the usual cases in that the detached portion of the condyle became more or less disintegrated. The disintegrated fragment and the rough edges of the condylar defect produced a persistent irritation of the joint which resulted in the hypertrophic changes found at operation.

Recovery was rapid and satisfactory. The joint is now stable and painless and presents a range of motion from complete extension to nearly complete flexion.

CLINICAL CONFERENCE, HOSPITAL FOR THE RUPTURED AND CRIPPLED, NEW YORK, FEBRUARY, 1925

DR. R. WHITMAN—Result of Operative Correction of Congenital Pronation of the Forearm.

Dr. Whitman presented a case illustrating the operative correction of congenital pronation of the forearm in a boy four years of age. He said that in these cases there was usually bone union of the upper extremity of the radius with the ulna over an area of two or three inches. Attempts to separate the bones and to restore movement by arthroplasty were futile because the radius was so bent as to prevent supination. In this case a member of the staff had removed a section of the radius about three-quarters of an inch in length just below the area of union, but thought it impracticable to reduce the deformity because of its effect on the circulation. About a week later Dr. Whitman succeeded in forcing the forearm into supination, and after a period of fixation in plaster of about three weeks the attitude had been maintained by forcible manipulation. A roentgenogram just taken showed reformation of bone in the resected area, so that the result will be eventual fixation with the palm up instead of down, a very considerable functional improvement.

DR. A. KRIDA—Multiple Tendon Transplantation for Median and Ulnar Nerve Paralysis.

Dr. Krida presented a man 31 years of age, an assistant marine engineer, whom he first saw on September 15, 1924.

Six months previously he had sustained, among other more serious injuries, a long knife gash on the inner side of the right arm and forearm. Early operation had been done, including a repair of the median nerve. Gas bacillus infection had supervened, invalidating the repair. At the time of examination he presented a fourteen-inch scar, with a complete ulnar lesion, with an intensely tender area about three inches above the wrist, and a substantially complete median lesion, there being complete paralysis of the muscles supplied by the median nerve, but a palmar hyperaesthesia and trophic changes suggesting a partial lesion.

At operation, on September 24, the nerves were explored. The ulnar nerve was found to be quite badly scarred throughout the forearm down to three inches above the wrist, where there was an ill-defined neuroma. The median nerve ended in scar tissue just above the bend of the elbow.

The ulnar nerve was progressively sectioned above the neuroma for more than three inches before even passably good fibers were encountered. The upper portion was then transplanted to the front of the elbow, and a fair suture was rendered possible by flexion of the elbow and wrist. The end of the median nerve was left embedded in the flexor muscle mass.

It was evident that except for the probability of a certain amount of sensory

recovery in the ulnar domain, the lesion present was that of an irreparable paralysis of the median and ulnar nerves. The passive mobility of the involved articulations was very good.

On November 5, the following tendon transplantations were done:

1. Extensor carpi ulnaris flexor profundis 3-4-5.
2. Extensor carpi radialis longior flexor profundis 2.
3. Supinator longus flexor longus pollicis.

Motion was begun after two weeks. On January 5, 1925, all the transplants were functioning with a fair amount of power. Flexion of the terminal phalanx of the thumb was particularly good, but it was disappointing to note that function was greatly impaired by the total absence of opposition movements of the thumb. The hyperaesthesia due to the ulnar neuroma was entirely relieved.

On January 7 an incision was made over the thenar mass. The long flexcr was split longitudinally and the radial portion was inserted subperiosteally into the dorsal surface of the first metacarpal near its head.

At the present time opposition of the thumb is possible to the fourth finger, he can grasp objects between the thumb and index finger, and he has fairly good power in the flexors of the fingers. Function is progressively improving. Sensory paralysis is still substantially complete, but it is assumed that a considerable improvement will ake place through concentric substitution.

Dr. Gillespie—Simultaneous Fracture of Patella and Pott's Fracture.

Dr. Gillespie presented a case of a woman aged 46, injured August 22, 1924, by a fall produced by catching the left heel in a rug. The patient suffered from a fractured patella and a Pott's fracture on the left, and was brought to the Hospital for Ruptured and Crippled, where the fracture above the ankle was reduced by immobilization in a Stimpson splint. The operation on the fractured patella was undertaken the next day, the lateral expansions being united with interrupted chromic gut sutures, and plaster applied from the toes to the groin. A week later the stitches were removed and the wound had healed by primary union. On the tenth day the plaster was removed and passive motion begun at the ankle and knee.

All support was removed from the knee at the end of four weeks and from the ankle at the end of five weeks from the operation, and the patient was discharged from the Hospital having been able to walk about with the aid of crutches two weeks after the injury. The case was demonstrated six months after injury and possessed practically normal function at the knee and ankle joint. A recent roentgenogram showed a separation of the patella fragment about one-quarter of an inch, but otherwise the result was excellent.

Dr. P. Colonna—Tendon Transplantation and Astragalo-Scaphoid Arthrodesis for Adult Paralytic Drop Foot.

Patient, age 35, stenographer, was presented by Dr. Colonna to the Conference, to show the result of operation for paralytic drop foot.

Patient was first seen in November, 1923, when there was a right drop foot with complete paralysis of the tibialis anticus and extensor longus hallucis and very slight power in the extensor communis digitorum. Foot was held in equinus, could be passively dorsiflexed to about 85 degrees, but no active dorsiflexion was possible. Patient

received baking and massage for the next thirteen months without appreciable improvement, wearing a strap from the toe of the boot to the ankle when walking, and a right angle splint at night. In December, 1924, patient entered the hospital for an operation. The tendon of the peroneus longus was exposed, after which a medial incision was made exposing the pale, atrophic tibialis anticus and extensor longus hallucis. The tendon of the tibialis anticus was withdrawn from its sheath and divided as high up as possible. The tendon of the peroneus longus was transplanted obliquely through a subcutaneous channel across to the inner side of the ankle and threaded through the sheath of the tibialis anticus, being sutured to the base of the first metatarsal through an osseous canal. The astragalo-scaphoid joint was exposed and arthrodesed and the foot put up in slight calcaneus and varus. Plaster was bivalved at end of five weeks and baking and massage begun.

Patient was shown at the end of two months with excellent power in the transplanted peroneus longus, being able to dorsiflex the foot about 20 degrees, and to walk well, wearing an ordinary type of shoe.

DR. L. C. WAGNER—Fracture of the Neck of Femur Following Reconstruction Operation.

In October, 1923, Miss M., age 56, consulted me because of pain in the left hip. The duration of her trouble had been ten years, with increasing deformity and pain.

Patient was in good condition. The hip on the left side presented an extreme deformity, being practically fixed in adduction, flexion, and external rotation. Locomotion was characterized by a very marked limp. Roentgenogram showed a marked distorsion of the head of the femur resembling a cauliflower.

At operation the head of the femur was found to be on the rim of the acetabulum and greatly thickened by a cartilaginous overgrowth. The acetabulum was normal. A typical reconstruction was done, leaving a fairly elongated neck, the trochanter was fixed with a bone peg, and the deformity corrected.

The patient had a normal convalescence, was walking on crutches in about four weeks, and was discharged to go home in January. At this time there was no pain and very little limp. The patient was stretched at home and on visits to the Out-Patient Department. In the latter part of February, 1924, whether due to the extreme stretching or a misstep on the street, it is difficult to say, she experienced sudden pain in left hip and was obliged to take a taxi home. She suffered intensely for the next three weeks whenever any movement was made. There was no deformity and no shortening. A roentgenogram showed an impacted fracture of the reconstructed neck. She would not consent to fixation and was put to bed for three months and the pain disappeared. Since that time she has been up and the limp has gradually disappeared.

On examination in January, 1925, she walked with practically no limp, without support, and absolutely no pain. She could climb a ladder. There was about twenty-five degrees of flexion, ten degrees of abduction, and no shortening. She is entirely satisfied. The roentgenogram shows a pseudo arthrosis, which makes a suitable joint and allows the motion that is seen when she walks.

News Notes

At the Annual Meeting of the American Orthopaedic Association, held in May, 1925, the following officers were chosen for the coming year:

President: Michael Hoke, Atlanta; President-Elect: James T. Watkins, San Francisco; Vice-President: John Dunlop, Los Angeles; Treasurer: John L. Porter, Evanston, Illinois; Secretary: DeForest P. Willard, Philadelphia.

A new Chair of Orthopaedic Surgery has been created at the Dublin University (Trinity College). Mr. W. S. Haughton of Dublin, Senior Surgeon to Steeven's Hospital and the Incorporated Orthopaedic Hospital of Ireland, has been elected as the first holder of the Chair.

This appointment marks an epoch in the development of Orthopaedic Surgery in the British Isles, as no other University possesses a full Chair in this subject at the present time.

The Sir Robert Jones Medal and Association Prize of the British Orthopaedic Association for the year 1924 have been awarded to Mr. G. Perkins, Surgeon Royal National Orthopaedic Hospital, Orthopaedic Registrar St. Thomas's Hospital.

The Samuel D. Gross Prize of the Philadelphia Academy of Surgery for 1925, amounting to fifteen hundred dollars, has been awarded to Dr. John Alexander, Department of Surgery, University of Michigan Medical School, for his essay, entitled, "History, Present Practice, and Proposed Reform of the Surgical Managment of Pulmonary Tuberculosis."

The British Orthopaedic Association offers a prize of £50 and a Medal to be given by Sir Robert Jones for an Annual Competition amongst members of the Association of all grades for an essay on a subject in orthopaedic surgery.

The essay is to be submitted typewritten, together with any illustrations and specimens, and forwarded to the Secretary on or before December 31st in each year. It must not bear the name of the writer, but should be identified by a motto and accompanied by a sealed envelope bearing the motto on the outside and containing the name and address of the writer inside. Only the envelope of the successful candidate will be opened. Unsuccessful essays will be returned to the candidates on personal application.

The subject of the essay for 1925 is: "The Classification and Differential Diagnosis of the Different Forms of Arthritis." Essays to be submitted by December 31, 1925.

The subject of the essay for 1926 is: "Affections of the Epiphysis and Epiphyseal Regions of the Bones, with special reference to their late effects." Essays to be submitted by December 31, 1926.

R. C. Elmslie, *Hon. Secretary.*

1A, Portland Place, W. 1.

The section in orthopaedic surgery of the New York Academy of Medicine met on Friday evening, April 17, 1925. The following papers were presented:

Silk ligament in the treatment of habitual dislocation of the patella. James C. Wilson, Hartford, Conn. (*by invitation*).

The relation of orthopaedic surgery to personality. Ira S. Wile.

Changes in the bony spine, with special reference to root pains and spinal diseases, with remarks on the technique of the operation of laminectomy. Illustrated by lantern slides. Charles A. Elsberg.

On Friday evening, May 15, 1925, the programme was as follows:

PRESENTATION OF CASES, AND CASE REPORTS.

(*From Brooklyn Hospital*):

Sacro-iliac disease and symptomatic sciatica, complicated by renal condition (2 cases). Joseph I. Nevins (*by invitation*).

A case of osteochondritis diseccans of both knees: pathologic slides: X-ray. Donald E. McKenna (*by invitation*).

Report of a case of tenolith of the quadriceps tendon: specimen. G. H. V. Hunter (*by invitation*).

(*From Lenox Hill Hospital*):

Peroneal tenodesis for paralytic equino-varus.

Bifurcation operation for ununited fracture of the neck of the femur.

Coxa vara luxans. Walter I. Galland (*by invitation*).

Torticollis: operation. Irwin Alpert (*by invitation*).

PAPERS OF THE EVENING:

The cure of congenital hip dislocation in infancy. Charles H. Jaeger.

Fractures and dislocations. R. Tunstall Taylor, Baltimore, Md. (*by invitation*).

Current Literature

CONGENITAL DEFORMITIES

CONGENITAL GENU RECURVATUM. PATHOGENY AND TREATMENT. L. Bazert. *Revue d'Orthopédie*, March, 1925, p. 155.

The condition is believed to be due to aplasia of the quadriceps with secondary bone changes. When possible the anterior dislocation of the tibia is reduced by hyperextending the knee and then sliding the tibia back over the femur. When this fails the operation of Ombrédanne is indicated. The patella is exposed by a long vertical incision and the quadriceps tendon divided obliquely as high up as possible and the subluxation is then reduced. The patella and the patellar tendon are then split and half of the patellar tendon cut from the tibia and turned up and sutured to the quadriceps muscle, thus lengthening the tendon. The capsule is reconstructed and the wound closed. The limb is fixed in plaster in slight flexion. With massage and mobilization an excellent result is possible.—*J. A. Key, M.D., St. Louis.*

MALFORMATIONS AND SUBLUXATIONS OF THE HIP. G. Nové-Josserand. *Revue d'Orthopédie*, March, 1925, p. 85.

1. In young children malformations and slight subluxations of the hip are frequent, but difficult to diagnose. They are characterized by shallowness of the acetabulum. With strong muscles and capsule there may be no limp or an intermittent limp with fatigue. There is about one centimetre of shortening, and Trendelenburg's sign may be positive. The treatment is reduction and fixation in abduction for eight months in complete abduction.

2. At 5 to 15 years the author has seen sixteen cases characterized by acetabula which are either shallow or have defective upper borders. Deformities of the head of the femur are inconstant. The signs and symptoms vary with the degree of luxation. Reduction and fixation in abduction is apt to result in an arthritis. Treatment is rest, and in painful cases immobilization for three months in plaster.

3. The author has seen thirteen cases in adults. In five of these there had been a congenital dislocation of the opposite hip. Eight cases had simple painful hips and the other five had definite progressive dry arthritis. Treatment consists of rest and physiotherapy. The author believes that these minor defects in the hip are evidence of subnormal bone which is less resistant to trauma and infection than normal, and that they predispose to osteochondritis, adolescent coxa vara, or dry arthritis.—*J. A. Key, M.D., St. Louis.*

CONGENITAL ABSENCE OF PATELLA. Voelcker. *Deutsche Ztschr. f. Chir.*, December, 1924, p. 24.

The author gives a short review of the different methods for treating dislocations of the patella which are probably due to a congenital defect.

He then describes a severe case of congenital dislocation of the patella in a sixteen-year-old boy. The usual methods of capsulorrhaphy, capsule excision, tendon transplantation, or osteotomy of the femur could not be expected to give a satisfactory result. A method was devised to transplant the entire extensor apparatus. The tuberosity of the tibia was chiseled free. Then the quadriceps tendon, patella, and patellar ligament were all drawn through the capsule of the knee joint on the medial side. The ligament was fastened to the tibia by making a T-shaped incision into the periosteum and suturing the periosteum over the tuberosity. The gap in the lateral side was closed by freeing folds of synovia from the recessus subcruralis.

The limb was put in a cast for four weeks. The tuberosity had grown fast to the tibia. Motion was started and a good functional knee was attained.—*E. D. Hauser, M.D., Rochester, Minn.*

TRAUMATIC CONDITIONS

FRACTURES OF THE SHAFT OF THE FEMUR. W. D. Andrus. *Annals of Surg.*, December, 1924, p. 848.

This is a report of eleven cases of simple fracture of the shaft of the femur treated in the Cincinnati General Hospital by adhesive traction and suspension from Balkan frame. There is a slight difference in the arrangement of weights and pulleys from that generally used. The results reported are very good. An additional forty cases of fracture of the shaft of the femur treated at the Cincinnati General Hospital are analysed in detail.—*F. G. Hodgson, M.D., Atlanta, Ga.*

FRACTURES OF THE SPINE. Emil S. Geist. *Minnesota Medicine*, January, 1925.

The paper does not consider isolated fractures of the transverse processes, laminae, or spinous processes, nor pathological fractures.

Seventy-four cases are reported. Nearly all occurred in the active period of life (twenty to thirty-five years of age) and in males. One-third had paralyses, in most cases total, below the involved spinal segment; in a few, a partial paralysis of an extremity. With paralysis present the diagnosis is easy, but in those without paralysis it was missed in about twenty-five per cent and the diagnosis subsequently made by careful X-ray examination. The X-ray examination should include lateral and stereoscopic antero-posterior views. Fracture of the spine by no means always presents unmistakable signs and symptoms, occasionally giving no symptoms whatever, at a late date. The causative trauma need not be of extreme severity. Disability was greatest in the dorso-lumbar spine, and ranged from 40 to 100%. Forty-five per cent showed deformity, usually kyphosis. The complaints of the patients, in order of frequency, were: rigidity of the back, inability to lift heavy objects, weak back, pain, and paralysis. Of twenty-two cases seen within the first forty-eight hours, twelve were operated upon (laminectomy). Four of these were benefited by operation, two died on the table, two shortly afterward, and four were not benefited. The author feels that laminectomy offers no brilliant hope

of relief of paralysis, but that without this operation the outlook is still more gloomy. There were thirty-eight "old" cases in the series, twenty-five per cent. having been diagnosed as "back strains." They complained of pain, rigidity, and inability to lift. Most of them were relieved by the application of braces. One case had a spinal fusion, with complete relief.

For fresh cases, without paralysis, the author advocates rest in recumbency, best on a Bradford frame, for ten or twelve weeks, followed by a cast and later a brace. In late cases, in good operative risks, he advocates a fusion operation; where operation is impracticable, fixation by bracing.—*Edward N. Reed, M.D., Los Angeles.*

Fractures of the Hip. Melvin S. Henderson. *Minnesota Medicine*, December, 1924, p. 786.

Only intra-capsular fractures are considered. In these the fractured surfaces are bathed in synovial fluid, and this the author considers to be the factor inhibiting callus formation. Moreover, the proximal fragment has no muscular or ligamentous attachments and very small blood supply, its nutrition being correspondingly scanty. Frail, elderly people may sustain fracture by indirect violence, the fall following the fracture.

Impaction may make walking possible after fracture, and fracture should be excluded only after careful radiographic examination. An important sign is the inability (except in firmly impacted fractures) to lift the heel from bed or table with knee extended. The classic clinical signs of fracture may be absent if the fragments are well impacted. It is unsafe to trust to impaction to produce a union. Some impacted fractures do unite, but many eventuate in non-union and absorption of the neck. The author considers the abduction method of Whitman the method of choice, the best means of securing anatomic restoration and fixation. The old belief that most fractures of the hip fail to unite must be revised. Only in patients with very little resistance, who cannot stand confinement, need this be true. Impaction should be broken up, the leg pulled down to normal length, and the hip swung out to full abduction, with foot in inversion. In this position the iliofemoral ligament is tightened and steadies the fragments. The position is maintained by a double plaster spica, or by traction in abduction, or by a Thomas splint. The Ruth-Maxwell traction method, if properly used, gives good results.

Reports of follow-up after the use of the Whitman method show a good proportion of bony union and a very high percentage of good functional results. In the presence of non-union a fibrous union is sometimes functionally very satisfactory. If not, a reconstructive operation should be considered, decision as to conservatism or operation, and as to type of operation, to be reached by study of the individual case. Where possible, pegging or grafting, to secure bony union between the fragments, is considered the method of choice, because it leaves the anatomic relations more nearly normal. The author prefers the fibula as graft or peg, as being larger and stronger than a piece of tibia. Where absorption of the neck is almost complete and fibrous union inadequate, there are to be considered (1) The Brackett operation, where the denuded upper end of the distal fragment is placed in opposition to the freshened surface of the head, after moving the trochanter, with muscular attachments, to a lower position on the shaft: and (2) The Whitman operation of removal of the head and placing the upper end of the lower fragment in the acetabulum, after reconstruction by moving the trochanter to a lower position on the shaft. All fractures of the femoral neck should be held in position until healing occurs, at least three months, with no weight bearing for at least six months.—*Edward N. Reed, M.D., Los Angeles, Calif.*

AVULSION OF THE ANTERIOR SUPERIOR SPINE TREATED BY OPERATION. A. G. Ord, *Lancet*, December 13, 1924, p. 1230.

Boy, 17. Limping and pain in right thigh following on kicking a football hard with right foot, and swinging round on left leg. There was swelling in the region of the anterior iliac spine. Limb was in slight flexion and internal rotation. About one to one and one-half inches below the iliac crest a small movable lump was felt. Crepitus was elicited. Diagnosis of avulsion of iliac spine was confirmed by roentgenograms.

Operation. The bony fragment was mobilized and fixed in position by catgut. The thigh was flexed, full extension being permitted on the ninth day. Nine days later he was permitted to resume football.

A second case in a boy of 17 was treated in the same way with the same result.

A third case, treated by strapping and recumbency, was still painful and incapacitated after eight weeks. The writer attributes the fracture to overaction of the sartorius when the thigh is flexed, adducted, and internally rotated.—*Alexander Gibson, F.R.C.S., (Eng.), Winnipeg.*

METHOD OF TREATMENT OF FRACTURE OF A SINGLE CONDYLE OF THE FEMUR WITH DISPLACEMENT BACKWARDS OF THE DISTAL FRAGMENT TO THE POPLITEAL SPACE. Lionel Sutcliffe, *British Journ. of Surg.*, January, 1925, p. 450.

The author briefly reviews the rather scant references to this special type of fracture and reports his fortunate experience with a fracture of the inner condyle in a young man of twenty years. The whole inner condyle was separated from the shaft and displaced behind the posterior plane of the femur. At operation a four-inch incision was made medially to the patella, and the joint capsule opened. The fragment was replaced and held in position by a Lane plate. Recovery followed with union of the fragment and complete function of the knee-joint.—*C. A. Parker, M.D., Chicago.*

ISOLATED FRACTURE OF THE TRANSVERSE PROCESSES OF THE LUMBAR VERTEBRAE. Pierre Wiart. *Bulletins et Mémoires de la Société Nationale de Chirurgie*, January 17, 1925, p. 30.

These fractures are said to be rare, only 31 cases having been reported.

A man twenty-six years of age was caught under a falling wall in such a manner that the weight came on his back, injuring him especially in the right side of the trunk. On examination his spine was found immobilized by violent pain, his right leg was weak, and he could not stand up. Sharp tenderness in the lumbar region a little to the right of the median line. Patellar reflex diminished on the right and an area of anesthesia on the right buttock. Roentgenogram showed fracture of the right transverse processes of the upper four lumbar vertebrae near their bases, or what might be called their necks. The fragments were separated outward and downward about one cm. The mechanism of these fractures is said to be sudden, strong contraction of the muscles which are attached to the transverse processes.—*William Arthur Clark, M.D., Pasadena, Calif.*

ISOLATED FRACTURE OF THE TRAPEZOID. Jean. *Bulletins et Mémoires de la Société Nationale de Chirurgie*, February 7, 1925, page 99.

Following a blow against a wall with his fist the patient had severe pain in the wrist and noticed a small, hard lump on the back of it. Extreme tenderness on pressure on this lump, but no crepitus, ecchymosis, or edema. Percussion on the head of the second metacarpal and forced motion of the index finger very painful in the wrist. The hard lump, which seemed to be bony, was just proximal to the base of the first metacarpal. There was no loss of function in the hand. Motion in the wrist possible in all directions except slight limitation of extension. Roentgenogram showed fracture of the trapezoid in three fragments with posterior displacement. Reduction was attempted by flexion of the wrist, traction on index finger, and pressure over the bone. Complete reduction was not obtained, but in two weeks no lump was noticeable and complete function was restored. The mechanism of this fracture seems to have been a direct shock on the trapezoid through the second metacarpal. The fragments were displaced dorsally, probably because of a slight flexion of the wrist. In another case the fracture was produced by a forced hyperextension of the wrist, and in this case it is thought that it may have been an avulsion fracture due to the pull of the dorsal metacarpo-trapezoid ligament.—*William Arthur Clark, M.D., Pasadena, Calif.*

RECURRENT EXTERNAL DISLOCATION OF THE PATELLA. Albert Mouchet. *Bulletins et Mémoires de la Société Nationale de Chirurgie*, January 17, 1925, page 2.

This is a report of one case observed three years after operation. A girl of sixteen had very loose patellae, especially on the left. This left patella was dislocated externally the first time as result of a twist of the knee while the patient was in bed. It was reduced easily by her father, but after this it could be thrown out very easily on flexing the knee. The external condyle seemed normal. There was a slight lateral mobility of the knee in extension. At operation an internal curved incision, with concavity anterior, was made. The joint capsule internal to the patella was cut longitudinally and the edges overlapped, thus shortening that side of the capsule, and sutured with horse hair. Since the operation (three years) the patella has not been dislocated, the knee has no lateral mobility and motion is normal. The left patella is still more lax than in a normal knee, but no more so than the patient 's right patella. It can not be dislocated on flexing the knee, as it could before the operation. The author admits that, while this is a successful operation in selected cases, it is sometimes necessary also to transplant the insertion of the patellar tendon internally if this tendon is elongated.—*William Arthur Clark, M.D., Pasadena, Calif.*

PARALYTIC CONDITIONS

MATERNAL BIRTH PALSY. C. Lambrinudi. *British Journ. of Surg.*, January, 1925, p. 554.

Lambrinudi reports two cases of this rare condition recently coming under his observation and quotes one published by Patel in the *Lyons Médical* of 1905. His two cases were in young women in their second pregnancies, with rather difficult births, in the first forceps under anaesthesia being used. In this case numbness and weakness were felt in the right lower limb immediately after the birth. This was followed by

severe pain in the back of the thigh and foot-drop which persisted for a year, but with much improvement. The second woman experienced cramp and severe pain in her right leg just below the knee after a difficult labor. On getting up three weeks later she also noticed a right foot-drop. "After two weeks the sensation had recovered, but the muscular weakness remained."

The review of the Patel case shows it to have been a woman twenty-five years of age, also in her second pregnancy with a forceps delivery. In this instance pain came on in the fifth month of pregnancy followed soon by foot-drop which was still present four months after the birth. In the first case high forceps were used and in the latter low forceps. These apparently had nothing to do with the paralysis.

Thomas, in the *Johns Hopkins Hospital Bulletin* in 1900, explained the conditions as follows: "The upper roots of the sacral plexus do not lie on the pyriformis muscle, but against the bony walls of the pelvis, and are thus exposed to pressure during certain difficult labors. It is the dorsal off-sets of these roots which lie against the bone and receive the chief injury. The external popliteal nerve is made up of these dorsal offsets and therefore the paralysis is chiefly located in the distribution of this nerve."

Lambrinudi believes this position is untenable on account of the difficulty of pressing upon the nerve in this position, and that a right sided paralysis may occur with a left occiput anterior. He believes it is due to a stretching of a normally very taut cord under special conditions favored by the mobility of the sacrum during child-birth. In cows a similar condition occurs accompanied by a large quantity of serum in the spinal canal and injection of the cord membranes, thus suggesting a root injury, which the author believes occurs in the human species.—*C. A. Parker, M.D., Chicago.*

Astragalectomy (The Whitman Operation) in Paralytic Deformities of the Foot. W. R. Mac Ausland and A. R. Mac Ausland. *Annals of Surg.*, December, 1924, p. 861.

This is a series of 247 cases by the authors. They claim that "astragalectomy has a distinct advantage over arthrodesis, in that it not only stabilizes, but also preserves motion."

Indications and contraindications are given. Operation should not be done until two years have elapsed since the original paralysis. It should not be done before the age of six to eight years. The operative technique and after care is very carefully described in detail. It is essentially the original operation described by Whitman, although there are some improvements added.

Out of 247 cases recently examined, operated upon from two to ten years ago, postoperative deformity developed in twelve; of these varus developed in seven. The results reported by Sever of cases operated upon at the Children's Hospital, Boston, were so much poorer than Mac Ausland's cases that he gives a discussion of what he believes to be the reasons for this. The paper is well illustrated, showing the details of the operation. Twelve cases are reported and illustrations shown. It is a very convincing article. The literature is discussed and a bibliography appended.—*F. G. Hodgson, M. D., Atlanta, Ga.*

End-Results of Operation for Claw-Foot. Alan De Forest Smith and Herman L. von Lackum. *Journal American Medical Association*, February 14, 1925, p. 499.

An investigation was made of 124 cases which had been operated upon by Hibbs's method. The operation consists in transferring the attachments of the extensor longus hallucis and extensor longus digitorum to a tunnel made in one or more of the tarsal bones, the plantar splinting of the toes to prevent curling up, and the envelopment of the whole in plaster-of-Paris for six weeks. Any necessary sub-astragaloid arthrodesis or correction of hollow foot should be done at a preliminary operation, because the traumatism is too great to be inflicted all at once. The conclusions of the authors are as follows:

1. The results of operation for transplant of the long toe extensors in cases of claw-foot are very satisfactory in properly selected cases because the mechanics are sufficiently changed to prevent recurrence of the deformity.

2. The cavus deformity first must be thoroughly corrected. In cases in which this is due to bony deformity it may be corrected by resection of the mediotarsal joint, but in these the removal of bone should be sufficient to accomplish the correction without extensive division of the plantar structures.

3. Any equinus must be corrected before or at the time of the operation.

4. If any lateral instability is present a subastragaloid arthrodesis must be performed prior to the transplant.

5. No other procedure involving trauma to the foot should be combined with the transplant operation.

6. The causes of bad results were failure to splint the toes long enough, with resulting recurrence of hyperextension; tendency of the toes to curl under following the transplant; incomplete correction of cavus; drop-foot because of weakness of the anterior group, including transplanted muscles, and poor lateral balance.

7. The negative effect of transplant on the toes frequently may be good, even though the transplanted muscles are too weak to have much positive effect in dorsiflexing the foot.—*H. A. Pingree, M.D., Portland, Me.*

A Case of Obstetrical Paralysis. Max Strunsky. *Medical Journal and Record*, February 18, 1925, p. 214.

Dissections of cases of chronic birth palsy have usually shown the ends of the torn nerves separated and imbedded in scar tissue, and attempts to reunite them have failed. However, the freeing of mechanical restraint by myotomizing contracted muscles and removal of bony obstruction has given most encouraging results.

The author reports a case, the patient 10 years of age, with typical limitation of abduction of the right arm, unimproved by prolonged treatment by many methods. The muscles involved gave a positive R. D. and very little response to electrical stimulation. The pectoralis major and subscapularis were divided at their insertion and many fibres of the serratus magnus divided. The arm was held in extreme abduction by plaster-of-Paris and then a brace, and passive and active movements done daily. The patient recovered almost complete abduction and the ability to touch the back of her head and the lobe of her ear with her fingers.

The Sever operation does not add power: it only overcomes obstructions. Nevertheless it is indicated when the antagonists of the deltoid are contracted, even with a paralyzed deltoid. Giving the rationale for this conclusion, the author goes carefully into the kinesiology of abduction of the arm. He thinks that the operation should be done on much younger children than at present is generally done.—*Edward N. Reed, M.D., Los Angeles, Calif.*

ARTHRITIS

ARTHRITIS OF THE MENOPAUSE. A STUDY OF FIFTY CASES. Russell L. Cecil and Benjamin H. Archer. *Journal American Medical Association*, January 10, 1925, p. 75.

The authors take up the arthritis of the menopause in a systematic, exhaustive, but brief manner and report three cases. Their conclusions follow:

1. The arthritis of the menopause is a definite clinical syndrome. 2. It is a chronic polyarthritis of obese, middle-aged women, occurring at or just after the menopause, and characterized by persistent stiffness and pain in the joints affected. 3. It is noninfectious in origin. 4. This form of arthritis appears to be definitely related to the endocrines, but the exact nature of this relationship has not been established. 5. The disease runs a mild chronic course. 6. Under a regimen consisting of iodids, low calory diet, and physiotherapy, a majority of the patients have been definitely benefited.—*H. A. Pingree, M.D., Portland, Me.*

SYPHILITIC SPONDYLITIS. Robert B. Cofield and Carl F. Little. *Journal American Medical Association*, January 17, 1925, p. 174.

The authors bring sharply to our attention the fact that many cases of lame back with bony destruction, kyphosis, and spasm are of syphilitic origin and that it should not be always taken for granted that they are tuberculous. Reports of three very interesting cases show that there is often no positive evidence to be obtained from blood examinations or the X-ray. Their conclusions follow:

While syphilitic spondylitis is not as frequently encountered as tuberculosis and ostearthritis of the vertebrae, it should always be considered as a possible etiologic factor in diseases of the spine.

Routine examination of the spine in secondary and tertiary syphilis will probably reveal a much higher proportion of cases of spondylitis of the arthralgic type than have hitherto been observed.

The gummatous type of spondylitis is often very difficult to differentiate from tuberculosis of the spine; the most notable contrasts being less pain on motion, sensitiveness not so marked over the lesion, muscle spasm not striking, especially in the uninvolved areas of the spine, and improvement of the condition following antisyphilitic treatment.

A rapidly developing painless deformity of the spine should always excite our suspicions of a Charcot arthropathy, and lead to further search for symptoms that will substantiate the diagnosis.—*H. A. Pingree, M.D., Portland, Me.*

CHRONIC INFECTIVE ARTHRITIS. A. Mackenzie Forbes. *Can. Med. Assoc. Jour.*, December, 1924, p. 1192.

A toxic infection is an important etiologic cause in all cases. In a certain percentage of cases, abnormal conditions in the intestinal canal are primarily concerned. In some cases the original focus may have been removed yet other foci be established. The intestinal epithelium itself may serve as a portal of entry. There is also a definite relationship in some cases between the character of the food taken and the incidence of symptoms of arthritis. Defective sugar tolerance, and diminished blood calcium may also be associated. The suggestion is made that the initial lesion is in the parathyroid, thus opening a door of infection in the intestinal mucosa. Objection is made to Goldthwait's classification inasmuch as the writer believes that in all cases the etiologic factor is an infection. Further, he maintains that all cases are polyarticular. The incidence is at any age. In childhood it appears as "Still's Disease." In mid-life it is frequently "atrophic." In later life it is often "hypertrophic." It is met with in rich or poor. Pathologic observations have not been of much service. Biochemistry is more likely to add to our knowledge. In diagnosis tubercle must always be kept in mind. Tuberculosis is rarely polyarticular; chronic infective arthritis is usually so. In tubercle, muscular atrophy is early; in infective arthritis it appears later and is not so marked. Charcot's disease and acute rheumatic fever should offer no difficulty in differentiation.

Defective knowledge of etiology involves a defective scientific base for treatment. Search for focal infection is the first procedure. Mouth, throat, sinuses, ear, genito-urinary tract, abdomen must be investigated. An autogenous vaccine may help to increase general resistance. Diet regulation is important. Repeated examinations of blood and urine must be made with special reference to sugar tolerance. Iodine and iodine salts are useful to some extent. Local treatment depends on the individual joint. In some cases rest is necessary to relieve the pain. In others, massage and more active treatment may be desirable. Many cases require hospital study and care. While there is no specific remedy, improvement is certain in the majority of cases carefully tended.—*Alexander Gibson, F.R.C.S. (Eng.), Winnipeg.*

SPONDYLITIS ANKYLOPOETICA. M. J. Gutmann. *Deut. med. Wchnsch.*, January 9, 1925, p. 67.

The author reports a case of arthritis which ran a very unusual course. It had all the findings and symptoms of a spinal cord tumor. Furthermore, it was of interest because the sensory function in the lower extremities reappeared after anesthesia had been present for several months in spite of the fact that the arthritis progressed.

The patient died of pneumonia, and at autopsy there was found an increased calcification of the blood vessels. The dura had become adherent to the spine. In certain areas there were projections arising from the vertebrae protruding in the cord. Sections of the cord showed degeneration.

It is significant to note that the dura had become adherent to the spine (Bechterew). While Bechterew described an extensive degeneration of the peripheral nerves, however, the degeneration in this instance was in the cord itself.—*E. D. Hauser, M.D., Rochester, Minn.*

SPONDYLITIS DEFORMANS. R. L. Knaggs. *British Journ. of Surg.*, January, 1925, p. 524.

The author in this rather detailed article separates the large general class of spondylitis deformans into three special classes and gives examples of each with differential points to support or prove his contention for this trifold division for a proper understanding of the subject.

The first class he designates as spondylitis ossificans ligamentosa, and in it he places those forms whose pathology apparently primarily involves the ligamentous structures, although the joints of other regions of the body are often involved. The diagnostic sign is ankylosis. This is the "poker spine" type.

His second class, called spondylitis muscularis, he reserves for the excessively curved backs common to old persons and others, often characterized by root pains as emphasized by Bechterew. Atrophy of intervertebral disks is an important factor in the development of the characteristic deformity.

Finally, there is the spondylitis osteo-arthritica in which marginal osteophytes characterize the vertebrae, with or without actual union of those of adjacent vertebrae. This is a rather common form as seen in osseous specimens. Treatment is not taken up in this article.—*Charles A. Parker, M.D., Chicago.*

SPONDYLITIS AFTER TYPHUS AND RELAPSING FEVER. L. v. Holst. *Zeitsch. f. Orthop. Chir.*, 1925, p. 321.

The author reports 56 cases of spondylitis after typhus and relapsing fever, and two cases after typhoid fever. The disease is characterized clinically by severe pain, which begins suddenly or develops rapidly, the pain subsiding in a short time even without any treatment. Other symptoms are referred pain, radiculitis, spinal tenderness, kyphos, scoliosis and stiffening of the spine, contracture of the lower extremities, paresis and paralysis. The site of the disease is mostly the lumbar vertebrae. The roentgenogram is characteristic in virtue of: 1, narrowing of the intervertebral space; 2, relatively little changes of the vertebrae; 3, the formation of bony, bridgelike proliferations or irregular bone growths which unite the affected vertebrae. The spondylitis from typhoid, typhus, or from relapsing fever is very much alike and cannot be differentiated, while from tuberculous spondylitis a differentiation is possible clinically and roentgenologically. The spinal condition may be classed with chronic infectious spondylitis. The disease process does not progress to abscess formation, and the prognosis is favorable.—*A. Gottlieb, M.D., Los Angeles, Calif.*

RECONSTRUCTION OPERATION FOR ARTHRITIS DEFORMANS OF THE HIP JOINT. Royal Whitman. *Annals of Surg.*, November, 1924, p. 779.

This operation was originally devised by Whitman for the treatment of old ununited fractures of the neck of the femur. He has now extended its use to those chronic, painful, disabling hips associated with hypertrophic spurs on the acetabulum and femoral head. He claims that his operation has a decided advantage over arthrodesis or resection. The operation is described. Seven cases form the basis of this report, the first in November, 1922. The results seem to justify the procedure.—*F. G. Hodgson, M.D., Atlanta, Ga.*

NEOPLASMS

BONE TUMORS: MYXOMA. J. C. Bloodgood. *Annals of Surg.*, December, 1924, p. 817.

This is a second paper, with report of three new cases. The first complete report was published in the *Annals of Surgery*, December, 1920. Every myxoma of bone on record has recurred locally and four patients subsequently died of metastasis. "My studies up to date emphasize that myxoma, either central or periosteal, is for practical purposes, a sarcoma, with much greater tendency to recurrence from wound transplantation and with a longer interval before death from metastasis." "When a patient is under 18 . . . . a distinct central tumor of the shaft of a long pipe bone is always benign." The three additional cases are discussed in detail. He advises resection or amputation without exploration when the diagnosis of myxoma is made. When exploration is required for diagnosis it should be done with actual cautery. The author uses small soldering irons of different sizes and shapes. This is another one of Dr. Bloodgood's valuable contributions to the subject of bone tumors. It should be read in full by all who are interested in this subject.—*F. G. Hodgson, M. D., Atlanta, Ga.*

CHRONIC BONE ABSCESS COMPARED TO JUXTA ARTICULAR TUBERCULOUS OSTEITIS. A. Rendu, *Revue d'Orthopédie*, March, 1925, p. 123.

Bone abscess occurs most frequently in the lower diaphysis of the tibia and usually begins with pain, characterized by nocturnal exacerbations. The pain and disability may subside after a few days or persist for three months or more. The abscess rarely forms a sinus, but remains stationary, and usually there is no synovitis of the neighboring joint. Tuberculous osteitis shows no predilection for the tibia and causes little or no pain, and progresses rather rapidly with synovitis of the adjacent joint and sinus formation. On physical examination the two lesions are similar and they can not be distinguished by the roentgenograms. The same may be true of the condition found at operation, and even pathologic and bacteriologic examination may fail to make the diagnosis. The same type lesions may be due to syphilis or to mixed infections. The treatment is surgical.—*A. J. Key, M.D., St. Louis.*

LOOSE BODIES IN THE ANKLE JOINT. George H. Stevenson. *British Journ. of Surg.*, January, 1925, p. 611.

Foreign bodies in the ankle joint are rare. It is on this account that Stevenson reports a case occurring in a young man aged 22 years, who four years previously had suffered a supposedly slight injury of the right ankle. The joint remained painful and slightly swollen. A roentgenogram showed an irregular shadow just behind the internal malleolus. The joint was opened in this region and a typical "loose body" with a bony nucleus was removed, with a similar smaller body about the size of a pea. The larger body measured approximately one by three-quarters inch.—*C. A. Parker, M.D., Chicago.*

MULTIPLE MYELOMATA. Willard J. Stone. *Am. Journ. Roentgenology*, December, 1924, p. 543.

The rarity of this condition is commented on, the history of its discovery briefly outlined, and a short description of its histo-pathology given. Bence-Jones albumose is constantly present in the urine. The author could find no record of benefit from X-ray treatment. The disease invariably runs a fatal course.

One case is reported, a man, white, age 56. The history is of pain in the back, transitory at first, but constant for the last eighteen months of his life, and unrelieved by orthopaedic and X-ray treatment. About a year after the first onset of pain, a portion of rib was resected, which showed, microscopically, a nodule within the bone made up of large cells of plasma type, in which were definite blood channels with endothelial walls. In the bone outside the nodule were small plasma cell foci. Small nodules, painful and of bony consistency, developed on various bones. A spontaneous fracture of the right femur occurred. The blood picture was not remarkable; the Wassermann reaction was negative. The roentgenograms showed an advanced destructive process involving the entire spine, pelvis, femurs, clavicles, many ribs, and the skull, of a type of metastatic malignancy. Death occurred from exhaustion twenty-two months after the first onset of pain. Autopsy showed multiple myelomata.—*Edward N. Reed, M.D., Los Angeles, Calif.*

TREATMENT OF CYSTIC OSTEITIS. H. Rouvillois. *Bulletins et Mémoires de la Société Nationale de Chirurgie*, January 24, 1925, page 33.

The author reports a case of cyst of the tibial shaft which he treated by partial resection and by bridging over with a bonegraft. Five months after the resection an osteo-periosteal graft was applied to the freshened bone, passing well above and below the cyst cavity. The functional result was excellent. The anatomic result, as shown by a series of roentgenograms, was a restoration of the tibia to its normal form. It is concluded that merely crushing a cyst wall in is not enough, but the walls should be resected down to good live bone and a graft put in which will, by its osteogenetic action, fill in the cavity. This technique is available only in cysts of the shaft and not in those in close proximity to joints.—*William Arthur Clark, M.D., Pasadena, Calif.*

DISEASES OF BONE

A CASE OF UNILATERAL AFFECTION OF THE SKELETON OF UNKNOWN ORIGIN. H. A. T. Fairbank. *British Journ. of Surg.*, January, 1925, p. 594.

Fairbank reports the X-ray findings in a peculiar condition affecting the bones of the right side of a boy of twelve years of age. His attention was called to the boy by the child's parents, who had observed some clumsiness in the use of the right leg, with no history of disease, trauma, or congenital defect to cause it.

A radiogram of the right hip disclosed a general osteoporosis of the bones entering into the formation of the hip, extending through the epiphyses and into the shaft. It was not the appearance of fibro-cystic disease. There were rather dense lamellae extended upward from the calcar femorale while the surrounding tissues appeared less

dense than normal. These dense lamellae were also noted in the epiphyses of the knee and to a less extent in the ankle, and the porosity with stippling was observed in the shoulder, while the bones of the right hand showed slight differences from those of the left. The roentgenograms are not those of sclerosing osteitis or of osteo-genesis imperfecta, and the changes are unilateral.—*C. A. Parker, M.D., Chicago.*

BRODIE'S ABSCESS. Melvin S. Henderson and Harold E. Simon. *Archives of Surgery*, November, 1924, p. 504.

Here is a comprehensive review of the literature with an analysis of the subject based upon an experience of thirteen cases. Etiologically the staphylococcus was found in three cases, five cases failed to show any organisms, and the others were not examined. In five cases a special search was made for the tubercle bacillus, with negative results. In two of the cases there was a history of previous osteomyelitis. In twelve of the cases the tibia was involved, the femur being the only other bone involved. Symptoms had been present anywhere from five weeks to fourteen years. The abscesses were in spongy bone and there was a surrounding sclerosis. The cavities contained fluid varying from clear to creamy pus. Bone cysts lack the encircling sclerosis. It is difficult to differentiate from a tubercular abscess of the bone. The only sure method of doing so is by the microscope and by inoculation. Treatment consists of aseptic drainage, curettage, and primary closure, although in a few cases open drainage is necessary. All but two of these thirteen cases reported because of pain. In seven of these this pain was in the nearby joint. In all cases the onset was gradual, severe pain being late in developing. In all there was enlargment of the end of the affected bone. Twelve thousand was the highest leucocyte count. In eight cases the results following operation were satisfactory. In four cases discharge occurred one, two, five, and seven months after operation. Treatment was simple drainage with primary closure in two cases. In more active cases currettage and drainage was employed, plus antiseptic swabbing. The authors believe the lesion must be explained on the basis of a dormant focus coming to life because of a lowered resistance.—*Edward Harlan Wilson, M.D., Columbus, Ohio.*

FIBROCYSTIC DISEASE OF BONE. J. B. G. Muir. *Lancet*, December 6, 1924, p. 1170.

The pathologic origin of cysts in bone has been a matter of contention. Apart from hydatid disease, the majority have been attributed to degeneration of myelomata. In one group of cases one or more cysts occur in pre-formed fibrous tissue replacing the compact bone. Knaggs' classification is recalled.

1. The prime change is the development of a mass of fibrous tissue.
2. Such a uniform mass shows signs of degenerating into cysts.
3. Much bone is developed, and the disease appears to be coming to an end.
4. Single cysts of bone.

Case 1. Girl, 14. Fell on right hip; was admitted to hospital three weeks later complaining of pain over great trochanter. A year later readmitted with enlargement of subtrochanteric region. Roentgenogram showed this to be a cystic cavity. Vascular myxomatous tissue was removed and diagnosed microscopically as spindle-celled sarcoma.

Curettage of the cavity four months later was followed by an identical pathological report. Since then (July, 1921) patient has been perfectly well; the affected femur is normal.

Case 2. Girl, 14. Supracondylar fracture right femur in November, 1920. Good union secured with ordinary extension. June, 1921, readmitted; spontaneous fracture in same locality. Roentgenogram showed large cystic cavity expanding the bone. Greyish gelatiniform mass was protruding from the femur. Pathological report: myxoma, blood-vessels numerous, large areas of haemorrhage. Possibility of this tumor being a sarcoma in which mucoid degeneration has occurred must be borne in mind. Readmitted July, 1922. Cavity curetted. Diagnosis fibrosarcoma. In December, 1923, swelling much increased. Amputation through middle third of femur. Since then patient has been well.

Pathology. There is a large multilocular cyst with numerous small cysts. The knee joint is intact, though erosion of the cartilage has begun. Microscopically invasion by delicate connective tissue with scanty spindle-shaped nuclei. In places the reticulum is definitely fibrous. There is an entire absence of fat and of any giant-cells of the myeloma type.

Summary: The preliminary change is the appearance of fibrous tissue in the marrow which becomes entirely replaced. Later invasion and absorption of bone occurs. A later development is the formation of cystic spaces within the fibrous tissue, the coalescence of these leading to larger cysts. If curettage be early and thorough, this should be sufficient. Later amputation may be necessary. Why should bone be replaced by fibrous tissue? It is hard to say. Knaggs has suggested a toxic origin. The writer suggests a primary myxo-fibroma of bone in which, in rare cases, several bones may be affected. Four illustrations are furnished.—*Alexander Gibson, F.R.C.S. (Eng.), Winnipeg.*

A Case of Osteitis Fibrosa. H. W. Southgate. *Lancet*, December 6, 1924, p. 1172.

Female patient, 40. Complaint: pain in sides, back, and head. History of "rheumatism" for years. Present illness began three years ago with general weakness, gradually increasing. The sternum was convex forward; slight thoracic kyphosis; no noticeable bowing of the limbs. Marked albuminuria. Death occurred shortly after admission.

Postmortem examination showed irregular thickening; the bone could be cut with a knife. The cut surface presented a speckled appearance with minute translucent areas studded through the bone. The ribs were fragile. On one of them a large swelling was present. The vertebrae could be cut through with a knife. The right femur was broken accidentally during the examination. The limb arteries were extremely narrowed and calcareous. The coronary arteries were sclerosed. The kidneys were small and cirrhotic. The history of intermittent pains, the haphazard calcification and absorption, the bone tumors and the extreme atheroma of the smaller vessels point to Paget's disease. The post-mortem findings and histologic changes resemble those described by von Recklinghausen in Virchow's "Festschrift." Six illustrations accompany the article.—*Alexander Gibson, F.R.C.S. (Eng.), Winnipeg.*

TWO CASES OF OSTEOMYELITIS TREATED BY VACCINE. Charrier. *Bulletins et Mémoires de la Société Nationale de Chirurgie*, December 13, 1924, p. 1100.

Case 1. A man of twenty entered the hospital May 19, in extreme prostration. Temperature 38.6 degrees, pulse 118. Sharp pain in upper part of the left thigh began May 5, accompanied by a chill, and reached its maximum in twenty-four hours. He had repeated chills and could not sleep, and after two days developed a swelling in upper part of thigh. On May 20 the fever was 39.9 degrees, the thigh lay in moderate flexion and abduction, acutely tender on motion or palpation. Swelling, redness, and subcutaneous venous engorgement were present. That evening, four hours after 0.5 cc. of staphylococcus vaccine had been injected, the temperature was 38.8, and the pain was somewhat ameliorated. May 22 another dose of vaccine, 1 cc., was injected. May 27. Decided amelioration of local and general symptoms, temperature, pain and swelling on the decline. June 7. The leg had an almost normal appearance. A week later the patient got up without permission, and had a recurrence of pain and fever, but with one more dose of vaccine he left the hospital five days later, apparently cured.

Case 2. Man of twenty-eight admitted to the hospital July 31 with pain in the left knee and fever. Swelling of lower part of thigh, knee in moderate flexion, entire leg tender and edematous. Temperature 38.4 degrees. General condition fairly good but pain violent. After the injection of 0.5 cc. staphylococcus vaccine the temperature came down to 37.9. The next day 1 cc. of vaccine was given, following which the swelling was noticeably diminished. Altogether eleven injections were given, and two months later the symptoms had all disappeared, except slight limitation of motion in the knee, which was improving. Six months later a roentgenogram showed an area of hyperostosis on the inner aspect of the femur.

These two cases, although not conclusive in themselves, add to the evidence in favor of vaccine therapy in acute osteomyelitis.—*William Arthur Clark, M.D., Pasadena, Calif.*

BONE AND JOINT SURGERY

ARTHOPLASTY FOR ANKYLOSIS OF THE KNEE. M. Ceballas. *Jour. de Chirurgie*, March, 1925, p. 132.

The author recommends spinal anaesthesia and the use of a tourniquet. The operation is as follows: 1. A lateral skin incision is curved forward below to cross the anterior tuberosity of the tibia. The cutaneous flap is then dissected to expose the patella. 2. The quadriceps tendon, patella, and patellar tendon are split and freed from the femur. 3. The tibia is separated from the femur with a chisel and the knee is flexed. The remnants of the capsule, crucial ligaments and semilunar cartilages are removed. The bone ends are reshaped with chisel and file. The amount of bone removed varies in each case, the tibia being hollowed out and the condyles reshaped to give correct alignment. 4. A large rectangular strip of fascia lata is removed from the lateral surface of the same thigh. 5. One end of the free graft is sutured to the front of the tibia. Its middle is sutured in the posterior part of the joint space and its free end is reflected and sutured over the lower end of the femur, thus leaving two layers of fascia between the bone ends. 6. The wound is closed with chromic catgut,

and two rubber tissue drains are inserted. Traction is applied for fifteen days. Active movements are encouraged in the first few days and active exercise with apparatus is begun at about twenty days.

Results: Sixty-three per cent. good, ten per cent. fair, and twenty-seven per cent. failure. He feels that these can be improved by a more rigid selection of cases. The contra-indications are discussed. The advantage of the author's operation is that the lateral ligaments are preserved.—*J. A. Key, M.D., St. Louis.*

Access to Shoulder and Hip. E. Payr. *Archiv f. klin. Chir.*, December 30, 1924, p. 487.

The method of Langenbeck for shoulder and hip operations means the separation of the tuberculum or trochanter, as the case may be, with its muscular attachments. This conserves the muscles. Yet the time it takes for bony union of the separated part to take place delays the onset of active as well as passive movement at the joint. If an ankylosis is desired this is of no importance, but where a movable joint is to be maintained it is of greatest importance to begin motion as early as possible.

The author has found that for certain types of cases sufficient exposure can be gained by conserving part of the muscles inserted at the tuberculum or the trochanter major. A complete description of the technique is given, which is very similar to the usual procedure, except that in the case of the shoulder the tuberculum minor is not touched. In the hip the procedure is more difficult. Here the trochanter major is reached in the usual manner. The tendon of the gluteus medius, however, is left alone and only the anterior third of the greater trochanter is separated. If the acetabulum is to be exposed radial incisions are made into the labium glenoidals, and the head is dislocated by means of abduction and external rotation.

The procedure is useful for the removal of osteophytes, any type of osteotomy, removal of foreign bodies, or plastic operations.—*E. D. Hauser, M.D., Rochester, Minn.*

Synovectomy and Fat Pad Removal in the Knee. Arthur Steindler. *Journal American Medical Association*, January 3, 1925, p. 16.

Dr. Steindler reports fourteen cases of operation upon knee-joints for the removal of abnormal tissue caused by trauma and disease. The paper is illustrated by twelve cuts showing microscopic views of material removed. He concludes that so far as concerns weight bearing without pain and proper alignment of the joint, the operation was beneficial in almost all cases, but that so far as motion is concerned, while the traumatic cases show as a result a much increased motion, the cases which were diseased do not improve in that respect. Some cases even had less motion than before the operation.—*H. A. Pingree, M.D., Portland, Me.*

Arthroplastic Operations for Ankylosis of the Knee. Alex. Ceballos. *Bulletins et Mémoires de la Société Nationale de Chirurgie*, January 24, 1925, p. 37.

The vertical split-patellar incision is used, the lateral ligaments being carefully preserved. It is important to restore as nearly as possible the anatomic form of the

joints and to keep the maximum of efficiency in the muscles and ligaments. When the articular surfaces have been modeled with curette and rasp the femoral condyles are covered with a free layer of fascia lata. The knee is then immobilized for about fifteen days in extension under traction, after which massage and motion are given systematically. It requires five or six months to obtain a final result.

The author has obtained good results in 68% of his cases and says that this percentage will be still better in the future because he has learned to select his cases. In fact, a judicious analysis of indications and counter-indications is one of the primary conditions of success. Cases in which the knee is ankylosed in extension are much more favorable than those in flexion because of the shortening of muscles, nerves, and vessels in the latter. It is best to transform an angular ankylosis to a straight ankylosis before attempting arthroplasty. The operation should not be done for an old tubercular joint, not only because the latent infection may again become active, but because the atrophy of the limb in general precludes good function.

Operation following recent arthritis is also inadvisable because of danger of stirring up the infection. Debilitated or nervous patients are poor risks because they will not coöperate well in carrying out the after-treatment. There is almost certain to be some lateral mobility, but if not excessive it does not interfere with good function if the muscles are strong. If excessive, it is usually due to too much resection of bone or to insufficient musculature. Incomplete extension following arthroplasty may be due to inaccurate modelling of the articular surfaces or to an abnormally long patellar tendon. Recurrence of the ankylosis usually means that the operation has been done too soon after the infection which caused the ankylosis.—*William Arthur Clark, M.D., Pasadena, Calif.*

TUBERCULOSIS

Tubercular Osteochondritis. A. Lapointe. *Bulletins et Mémoires de la Société Nationale de Chirurgie*, January 17, 1925, p. 3.

Discussing a previous paper by Dujarier in which it was claimed that a case of osteochondritis of the rib was primarily tubercular, Lapointe says it is doubtful whether a hematogenous infection, tuberculous or otherwise, could occur in cartilage. Cartilage lives by imbibition and becomes vascularized only on ossification. Although a cold abscess was present in the case under discussion, it is probable that it was of lymphatic glandular origin. To establish a cartilaginous origin it would be necessary to find the abscess imbedded in and completely surrounded by the cartilage. In brief, the author concludes that primitive tuberculosis of cartilage does not exist.

In the discussion which followed Lapointe's paper, Algave said he had seen a tubercular abscess cavity in cartilage similar to the type usually seen in bone. Sorrel said he also had seen two such cases. Mouchet said he had operated on several cases of tubercular cartilage in which the lesion was cured by removal of the cartilage.—*William Arthur Clark, M.D., Pasadena, Calif.*

MISCELLANEOUS

Shoeing. Z. B. Adams. *Medical Journal and Record*, January 21, 1925, p. 85.

Many stock shoes are excellent if properly fitted. The commonest fault is in fitting

shoes too wide and too short, causing various troubles in front arch and toes. The principle criticism of shoe stocks is the lack of narrow sizes. A correctly shaped shoe may ruin the foot if improperly fitted. The shoe must fit the foot, not bind it. Shoes with strongly intwisted front simply cramp the small toes inward. Flexible shank shoes furnish no surface between front of heel and ball of foot upon which the midfoot can rest, and are illogical. The broadest part of the foot extends from the middle of the great toe across to the tip of the little toe. The foot should be so placed in the shoe that the tip of the little toe comes at the widest part of the sole. There should be an inch of empty shoe beyond the ends of the toes in blunt-toed shoes and more than an inch in pointed-toed shoes. The lacing of the shoe should hold the foot back against the counter, and never pressure by the vamp seam against metatarsal heads or shafts. People must learn how to shoe their own feet and not depend on shoe-salesmen. A properly fitted shoe should be as comfortable when first worn as when old.—*Edward N. Reed, M.D., Los Angeles, Calif.*

TREATMENT OF SCOLIOSIS. Max Blumenthal. *Med. Klin.*, January 11, 1925, p. 60.

The author describes a means of applying leverage to correct scoliotic deformities. A snugly fitting leather support is fastened to the pelvis. A vertical bar is attached to this posteriorly. From the upper end of the bar a horizontal arm passes laterally. To this is attached a curved plate. By means of curves in the rods, pressure is brought to bear on the convexity and at the same time there is a tendency to raise the depressed shoulder. In some cases two arms are applied and correction is made on both sides of the scoliotic curve.

For the treatment of scoliosis in infants and small children he has applied a plaster bed. The bed is made in the usual manner and then divided obliquely at the level of the juncture of the middle and the lower third of the scoliotic curve. The lower half of the cast is then fastened to a board. The upper half is attached only to the lower, and this by means of an extension mechanism. By increasing the gap between the casts, extension of the spine is brought about. Later the gap is increased only on the side of the concavity and in this way pressure is brought to bear against the convexity. The author has had twelve years' experience with this method and has found that the patients could stand it very well, and that it was particularly valuable in small children where actual redressment can accomplish the most.—*E. D. Hauser, M.D., Rochester, Minn.*

A CLINICAL STUDY OF DISEASES OF THE CIRCULATION OF THE EXTREMITIES; A DESCRIPTION OF A NEW METHOD OF EXAMINATION. Barney Brooks and Fred A. Jostes. *Archives of Surgery*, November, 1924, p. 485.

The authors present a new method of precision for measuring the normality of the arterial circulation of the extremities. The device consists of a protected thermocouple of iron and constant incorporated in a hypodermic needle to which is attached an electric galvanometer. The readings of the galvanometer are standardized by immersion of the needle in water at various known temperatures. The needle is thrust into the tissues to a depth of 6 mm. and the readings taken. There is always a slight rise following this procedure. After the temperature has become stable a tourniquet is applied

tight enough to interrupt the arterial circulation. This is left on ten minutes. During this time there is a definite gradual fall of from two to three degrees centigrade. The tourniquet is then removed and the temperature is seen to go back rapidly to normal. This is the reaction in a leg with normal circulation with the needle in the toe. In cases of obliteration of the arteries from various causes the curve was much the same until removal of the tourniquet. The rise to normal thereafter was always delayed, and in the worst cases preceded by a further fall in the local temperature. In the worst case, where the leg was blanched and cold, the tourniquet had no effect on the temperature.

The authors feel that they have a valuable method for determining the degree of arterial mal-function and that a further variety of readings in various cases will further standardize it.—*Edward Harlan Wilson, M.D., Columbus, Ohio.*

USE OF FREE TRANSPLANTS OF FASCIA AS LIVING SUTURES IN TREATMENT OF HERNIA. W. E. Gallie and A. B. LeMesurier. *Archives of Surgery*, November, 1924, p. 516.

The following conclusions are given on the basis of experiments performed. Wounds in fascia when sutured end-to-end heal by a delicate scar tissue incapable of sustaining much strain without stretching. Simple overlapping of tissues presents two undamaged surfaces which adhere together lightly and stretch easily. Scraping these surfaces before suture increases the strength of union, but it is still incapable of bearing prolonged strain. Linen sutures are most effective in holding edges together but tend to cut through, and have the usual disadvantages common to all foreign bodies. Side-to-side sutures of aponeurosis never result in union of a permanent nature and the same is true of muscle, as in suture of the recti muscles for ventral hernia. Free transplants of living tissue continue to live, but when sutured as described above have the weaknesses mentioned. Sutures of fascia lata one-half inch wide remained alive and did not stretch over a period of observation of two years. These sutures became covered with delicate vascular tissue, and in cross section had all the characteristics of normal tendon tissue. The technique is described. The essential point is that the sutures are looped through themselves by splitting them.—*Edward Harlan Wilson, M.D., Columbus, Ohio.*

THE COINCIDENCE OF PSEUDO COXALGIA AND KÖHLER'S DISEASE IN THE SAME PATIENT. T. J. D. Lane. *Lancet*, August 23, 1924, p. 368.

The author reports two cases met with at Meath Hospital in 1923, which tend to confirm the view of the French authors that there is not merely a radiographic resemblance, but an etiological connection between pseudo coxalgia and Köhler's disease. In both the author's cases apophysitis of the tibial tubercle (Osgood-Schlatter disease) was absent. The author stresses Sorrel's advice to examine radiographically both feet and hips in all cases of either condition. A detailed account with excellent radiograms of both cases is shown.—*N. T. Williamson, M.D., Montreal, Canada.*

CASE OF PROGRESSIVE MULTIPLE MYOSITIS OSSIFICANS. Alfred Wiesenthal. *Ztchr. f. orth. Chir.*, Bd. 45, H 3–4, 1924, p. 608.

The author adds another case of myositis ossificans progressiva multiplex to the literature. He sees no need for a change in the nomenclature, since the present name

describes the clinical picture. He reports a typical case coming on after an abscess of the back. A year and a half after the onset the muscles of the body, the chest, the thigh, arms, neck, and even the frontal and occipital muscles were involved, and caused a marked kyphos, flexion deformities, limitation of motion, as well as almost entire loss of chest expansion. The X-ray findings were typical and demonstrated microdactylia. The etiology, as well as the exact nature of the process, is unknown. The prognosis is bad. Most cases die of pulmonary infection. Roentgenotherapy seems to be the most hopeful method of treatment.—*E. L. Hauser, M.D., Rochester, Minn.*

ADOLESCENT COXA VARA. T. P. Noble. *Annals of Surgery*, November, 1924, p. 773.

This condition is described with a detailed consideration of the deformity and changes which take place in the head and neck of the femur. The clinical symptoms are given. Increased hyperextension at the hip joint without producing increased lordosis is considered characteristic. The usual treatment is outlined. The author does not mention the endocrines as a possible causative factor. He reports a case and shows roentgenograms of a typical case of slipped epiphysis. He does not mention the fact that the head could be replaced by open operation when closed reduction fails.—*F. G. Hodgson, M. D., Atlanta, Ga.*

GOUT. F. Umber. *Muench. med. Woch.*, December 12, 1924, p. 1758.

The constitutional anomalies, gout and diabetes, are so frequently associates that one is forced to consider the question whether gout is not to be classed among the constitutional endocrine disturbances, just as diabetes is. The endocrine anomaly leads to a retention of uric acid in the tissues, mainly in the so-called mesenchymal tissues: joints, periarticular structures, synovial sacs, periosteum, tendon sheaths, etc., which seem to have a heightened affinity to uric acid. The author quotes that in the last forty-two cases of gout, seven were afflicted with diabetes as well.—*A. Gottlieb, M.D., Los Angeles, Cal.*

CONTRIBUTION TO THE STUDY OF PSEUDOCOXALGIA. H. Vulliet. *Revue d'Orthopédie*, March, 1925, p. 149.

Lesions of the lesser trochanter in adolescents may simulate tuberculosis of the hip. The author reports three such cases. The first was an osteitis with foci elsewhere. The second was probably a localized osteitis, and the third followed a trauma, and subsequent roentgenograms revealed a condition in the lesser trochanter resembling the lesion of the anterior tuberosity of the tibia described by Osgood.—*J. A. Key, M.D., St. Louis.*

EVALUATION OF SCOLIOSIS IN BACK INJURIES. C. Goecke. *Arch. f. orth. u. Unfall-Chir.*, Vol. 23, No. 4, 1925, p. 408.

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a traumatic and a non-traumatic origin. The possibility of aggravating a physiologic or a static scoliosis by trauma is discussed and case reports are given. Congenital anomalies and variations of vertebrae with scoliosis seem to predispose to increased functional disturbance after an injury. The constitutional inferiority of the asthenic back is proven. Spinal curvature which results from muscular or nerve affections in the vicinity of the spine,—i. e., spinal postures adopted to avoid pain,—cannot be regarded as effects of injuries; they are easily corrected when the primary cause is cured and abolished. Pre-existing and overlooked rachitic curves are favored in their development by one severe or multiple minor injuries. They lose their weight-bearing efficiency and show a tendency to increase of the deformity even after the bone growth has ceased. Acute inflammations of vertebrae after infections with typhoid or coccus infections may produce scoliotic curves when intervertebral discs or bone substance is destroyed. A trauma occurring simultaneously must be regarded as a contributing factor. The post-traumatic spondylitis of Kuemmel may at times appear as a scoliotic instead of a kyphotic curve in the dorsal region of the spine. In traumatic deformities of the dorsal area a scoliosis convex to the right has predominated in cases where partial fractures of dorsal vertebrae have existed. This is explained on the basis that right-sided physiologic curving is the more frequent and prognosticates a similar scoliosis after trauma. In partial fractures of the lumbar vertebrae the entire lumbar region adopts a scoliotic curve, which has its base at the last lumbar vertebra. A strong secondary bone proliferation occurs in the vertebra whenever a constitutional predisposition exists which favors the production of bone tissue.—*A. Gottlieb, M.D., Los Angeles, Calif.*